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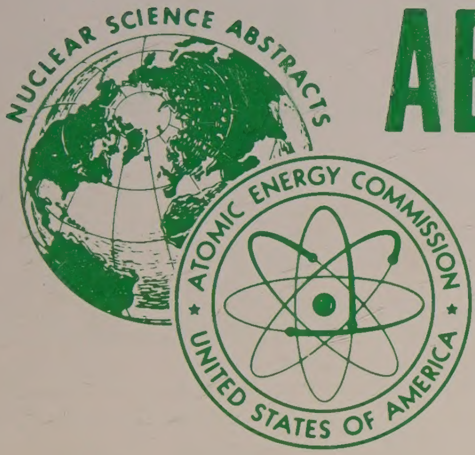
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Volume 26 Number 18

Abstracts 42690-45180

September 30, 1972

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NOTICE

A title page for Volume 26, Numbers 13–18, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 5-10, Subj. Index, page 172, under Computers, line 62 should read: design and operation on AVIDAC, 7:5778(R)

NSA Vol. 26, No. 8, Abst. 19737, line 4 should read: for Energy and development (AEC), Washington, D. C. (USA)). 40p. Dep. NTIS.

NSA Vol. 26, No. 9, Abst. No. 19930, line 2 should read: MATERIALS BY HIGH-ENERGY GAMMA-PHOTON ACTIVATION.

NSA Vol. 26, No. 9, Abst. 20086, line 8 should read: as H·, MH$^+$, OH, HalOH$^-$, and Hal$_2^-$. The effect of gradual annealing

NSA Vol. 26, No. 9, Abst. 20638, line 12 should read: times of 53, 200, and 435 days for ^{91}Y, ^{144}Ce, and ^{90}Sr, respec-

NSA Vol. 26, No. 9, Abst. 20640, line 17 should read: lungs and 8% in the remainder of the carcass. Mice with ILB of

NSA Vol. 26, No. 9, Abst. 21568, line 3 should read: $Nb_3Al_{0.8}Ge_{0.2}$. Pan, V. M.; Latysheva, V. I.; Sudovtsov, A. I.;

NSA Vol. 26, No. 9, Abst. 21568, line 15 should read: form of the region of homogeneity of the phase β-$Nb_3Al_xGe_{1-x}$

NSA Vol. 26, No. 11, Abst. 25388, lines 2 and 3 should read: Thakur, M. L.; Nunn, A. D. (Medical Research Council, London, Eng.). Int. J. Appl. Radiat. Isotop.; 23: No. 3, 139–40

Volume 26, Number 18, September 30, 1972

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director. Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of international nuclear science literature. *Nuclear Science Abstracts* covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Personal Authors

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TRANSURANIUM ELEMENTS
determination in bone ash, radiochemical method for,
25:40 (IDO-12073, pp 28-36)
separation by ion exchange and complex-formation elution,
25:251(P)

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complexes with cobalt(III) and rhodium(III) chlorides,
radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
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Plant, July through Dec. 1969, 25:258 (DOCKET-50201-
48)
content in Cattaraugus Creek near West Valley Processing
Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
determination in luminescent material by scintillation
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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Construction of a unique underground whole body counter,
25:372 (UCRL-72739)

Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 43172, 43473, 43631, and 43659.

42690 ANALYTICAL CHEMISTRY OF TELLURIUM. Cooper, W. Charles (Noranda Research Centre, Pointe Claire, Quebec). pp281-312 of Tellurium. /Cooper, W. Charles. New York; Van Nostrand Reinhold Co. (1971).

The separation and isolation of tellurium, its detection and identification, determination by various methods, analysis of tellurium, and determination of tellurium in specific materials are discussed. (126 references) (M.C.G.)

42691 ISOTOPIC EQUILIBRIUM. Simon, Claude. pp 185-204 of Colloquium of INSERM on Experimental Methodology in Thyroidian Physiology and Physiopathology. /Mornex, R. (ed.). Boulogne-Billancourt, France; Institut National de la Sante et de la Recherche Medicale (1971). (In French).

From Conference of INSERM on experimental methodology in thyroidian physiology and physiopathology; Lyon, France (21 Oct 1971). See CONF-711053.

The isotopic equilibrium method is a physiological method based on metabolite turnover in the stationary state. The method can be used for any biological constituent fulfilling this definition, and is particularly useful for studying the turnover of oligo-elements, such as iodine. The method must be carried out under precisely specified conditions. In experiments with the thyroid, the method enables the iodine pool to be studied. (France)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 42776, 42801, 42971, and 43407.

42692 (COO-3371-15) ACTIVATION ANALYSIS IN RESEARCH AND FORENSIC MEDICINE. Final Progress Report, July 1, 1971–September 30, 1971. Maletskos, Constantine J. (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). [nd]. Contract AT(30-1)-3371. 6p. Dep. NTIS.

The foil used as a standard in activation analysis for determination of Au was found to be, not gold, but Dutch metal (Cu and Zn). A study of ^{50}Cr-enriched material by activation analysis concentrated on finding a way to separate ^{51}Cr simply. (M.C.G.)

42693 (ORNL-TM-3747) ENVIRONMENTAL INFLUENCE ON TRACE ELEMENTS IN HAIR OF 15 SPECIES OF MAMMALS. Huckabee, John W.; Cartan, Frederick O.; Kennington, Garth S. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 38p. Dep. NTIS.

The usefulness of hair as a monitor of trace elements in the mammal's diet was studied by collecting hair samples and analyzing them by neutron activation to determine their trace-element content. No species-specific patterns of hair trace-element content were found. The trace-element content of hair does appear to be related to environmental distribution of trace elements. Variations in the trace-element content of hair may be due, in part, to food preferences, phenology of food organisms, microhabitat selection, physiological differences among species, and trophic level. Elements determined include: Se, Cr, Ag, Sc, Fe, Zn, Hg, Au, and Sb. (M.C.G.)

42694 NEUTRON ACTIVATION DETERMINATION OF TANTALUM IN MINERALS. Lobanov, E. M.; Babaev, A.; Khaidarov, A. (Physical-Technical Inst., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 1, 21-3(1972). (In Russian).

Tantalum was detected and quantitatively determined by activation analysis in the following minerals: rubellite, muscovite, microline, lepidolite, dravite, and cleavelandite. A 3- to 5-mg sample of the mineral and a Ta standard were irradiated in a thermal neutron flux of 1.8×10^{13} n/cm^2 · sec for three hr. After a 15- to 20-day period of short-lived decay, only ^{134}Cs and ^{46}Sc remained in addition to ^{182}Ta, and the photopeak at 69 keV was used for a quantitative estimation of Ta. (K.S.W.)

42695 DETERMINATION OF TOTAL BODY CALCIUM THROUGH ^{37}Ar RELEASE AFTER NEUTRON ACTIVATION. Palmer, H. E. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 42(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42696 NEUTRON ACTIVATION ANALYSIS MEASUREMENTS OF Hg, Se, AND Zn LEVELS IN ALBACORE AND DOLPHINS. Guinn, V. P. (Univ. of California, Irvine); Kishore, R.; Folsom, T. R.; Hodge, V. F.; Sargent, M. C. Trans. Amer. Nucl. Soc.; 15: No. 1, 68-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42697 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF LEAD MATRICES FOR MERCURY. Guinn, Vincent P. (Univ. of California, Irvine); Heydorn, Kaj. Trans. Amer. Nucl. Soc.; 15: No. 1, 70(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42698 TRACK ETCH ANALYSIS OF URANIUM PARTICLES AS A TRACER SYSTEM. Lovett, D. B. (General Electric Co., Pleasanton, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 121-2 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42699 MATERIAL IDENTIFICATION BY ACTIVATION ANALYSIS. Lukens, H. R.; Bryan, D. E. (Gulf Radiation Tech., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 148-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42700 ACTIVATION ANALYSES OF STABLE ELEMENTS USED AS NUTRITIONAL MARKERS. Gray, D.; Kay, M.; Vogt, J. R.; Luckey, T. D. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 15: No. 1, 149(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42701 TRACE-ELEMENT ANALYSIS OF HUMAN LUNG TISSUE BY NEUTRON ACTIVATION ANALYSIS. Lee, Bong K. (Pennsylvania State Univ., University Park); Lee, Young K. Trans. Amer. Nucl. Soc.; 15: No. 1, 150(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42702 RAPID INSTRUMENTAL ANALYSIS FOR MERCURY IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION. Friedman, Melvin H. (Food and Drug Administration, Washington, D. C.); Tanner, James T.; Miller, Eugene Trans. Amer. Nucl. Soc.; 15: No. 1, 150-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42703 DETERMINATION OF CHROMIUM LEVELS IN BLOOD SERA BY ACTIVATION ANALYSIS. Abu-Samra, A.; McKown, D. M.; Vogt, J. R.; Guthrie, R.; England, J. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 15: No. 1, 151-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jan 1972). See CONF-720607.

42704 ^{252}Cf FUEL ROD ASSAY SYSTEM: IN-PLANT PERFORMANCE. Smith, D. B. (Los Alamos Scientific Lab., N. Mex.); Forster, R. A.; Menlove, H. O.; Forehand, H. M. Trans. Amer. Nucl. Soc.; 15: No. 1, 174(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42705 PROMPT ACTIVATION ANALYSIS OF LIGHT ELEMENTS BY COINCIDENT MEASUREMENT OF COMPLEMENTARY PARTICLES. Pretorius, R. (Southern Universities Nuclear Inst., Faure, S. Afr.). Radiochem. Radioanal. Lett.; 10: No. 5, 297-307(30 Jun 1972).

A method for the determination of light elements by coincident measurement of complementary particles (CMCP) is described. This approach to prompt activation analysis has the advantage that it is highly specific and eliminates background and interferences almost completely. Unlike other coincidence measurements where coincident losses are large, coincident measurement of complementary particles can be carried out with excellent efficiency. The technique is illustrated by utilizing the ^{6}Li(d,α)^{4}He reaction for the isotopic analysis of lithium. (auth)

42706 USE OF A Ge(Li) DETECTOR IN RADIOCHEMICAL ANALYSIS. II. DETERMINATION OF U AND Th CONTENTS IN MICROSAMPLES OF ThO_2–UO_2 NUCLEAR FUELS. Neeb, Karl Heinz; Neidl, Herbert; Stoeckert, Heinz (Siemens AG, Erlangen, Ger.). Z. Anal. Chem.; 259: No. 4, 265-8(1972). (In German).

Neutron activation analysis with nondestructive γ spectrometry was used to determine U and Th in microsamples (0.5 to 1.5 mg) from ThO_2–UO_2 nuclear fuels. With U contents of more than 0.1% the relative standard deviation amounts to 6%. Th in the microsamples is estimated by measuring ^{233}Pa; in natural UO_2-containing samples ^{239}Np is measured for U determination, in highly enriched UO_2 samples ^{131}I. Fresh and spent ThO_2–UO_2 nuclear fuels can be investigated by the method described. (auth)

42707 IODINE ACTIVATION ANALYSIS IN BIOLOGICAL MEDIA. Riviere, R.; Girault, M.; Stulzaft, O.; Comar, D. (Hospitalier Frederic Joliot, Orsay, France). pp 349-66 of Colloquium of INSERM on Experimental Methodology in Thyroidian Physiology and Physiopathology. /Mornex, R. (ed.). Boulogne-Billancourt, France; Institut National de la Sante et de la Recherche Medicale (1971). (In French).

From Conference of INSERM on experimental methodology in thyroidian physiology and physiopathology; Lyon, France (21 Oct 1971). See CONF-711053.

Activation analysis can be used to determine iodine in biological media. After irradiation, natural ^{127}I transforms into radioactive ^{128}I, which can be measured directly by γ spectrometry or after chemical treatment. This method enables very small quantities of iodine (>0.0001 μg) to be determined. In vitro plasmatic iodine determinations can be performed. The iodine absorbed during special dieting conditions and thyroid iodine contents can also be determined (in vitro). ^{129}I can also be used for activation analysis (thyroid physiopathology research). Activation analysis (in vitro) can also be applied to man, the irradiation dose being of the same order of magnitude as that used in diagnosis with ^{131}I. (France)

42708 USE OF STABLE BROMINE WITH SUBSEQUENT NEUTRON ACTIVATION ANALYSIS TO DETERMINE EXTRACELLULAR FLUID PARAMETERS IN HUMANS. Ryabukhin, Yu. S.; Uspenskii, V. A.; Lyskova, M. N.; (and others) (Inst. of Medical Radiology, Moscow Engineering-Physics Inst.). Med. Radiol.; 17: No. 3, 24-30(Mar 1972). (In Russian).

Techniques of an instrumental neutron activation analysis of endogenous serum and urinary bromine was used for determining extracellular fluid volume and exchange rate in patients. The technique makes it possible to follow the extracellular fluid parameters for a long time and to evaluate results of the treatment. (auth)

42709 DETERMINATION OF INDIVIDUAL LANTHANIDE ELEMENTS BY NEUTRON ACTIVATION USING A NEW COMPARATOR TECHNIQUE. Lee, Chul; Yim, Yung Chang; Chung, Koo Soon (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 2, 83-9(Jun 1972).

The contents of the individual lanthanide elements were determined by neutron activation using a new comparator technique, which employs the short-lived radioisotope ^{56}Mn as a neutron flux monitor. The total rare earths were separated as a group from the monazite sample before irradiation. After irradiation the rare earths were separated from each other by gradient elution with ammonium α-hydroxyisobutyrate using a cation-exchange column. The contents of 14 individual rare earths, from lutetium to lanthanum, were determined. (auth)

42710 CHARGED-PARTICLE ACTIVATION ANALYSIS FOR TRACE IMPURITIES IN WATER. Bankert, S. F. (Univ. of California, Davis); Sauter, G. D.; Bloom, S. D. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 191-3(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A charged particle activation technique was developed to analyze for trace impurities in the ppM range or less in water. Water samples were evaporated onto a tantalum foil and activated in a 15-MeV proton beam. The gamma spectrum from the activated sample was analyzed to quantitatively determine simultaneously trace amounts of boron, bromine, sodium, cadmium, chromium, selenium, and nitrogen. Total irradiation and counting time is less than two minutes. Beam currents are $\lesssim 1$ μa. (auth)

42711 DETERMINATION OF TRACE-ELEMENT LEVELS IN ATMOSPHERIC POLLUTANTS BY INSTRUMENTAL NEUTRONACTIVATION ANALYSIS. Gray, Donald; McKown, David M.; Kay, Michael; Eichor, Matt; Vogt, James R. (Univ. of Missouri, Columbia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 194-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Sample collection and activation analysis techniques were evaluated for the study of air pollution particulates in a more or less rural area. The particulates were collected on filters and in a particle impactor. Elements determined include: Ti, Al, V, Ca, Mg, Cl, Mn, Na, Br, Sm, As, K, La, Hf, Ce, Hg, Cr, Sb, Sc, Fe, Zn, Co, Eu, Se, and Th. (M.C.G.)

42712 COMPUTER SYSTEM FOR RADIONUCLIDE ANALYSIS. Kosorok, J. R. (Battelle-Northwest, Richland, Wash.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 640-4(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

An interactive computer system for the acquisition and reduction of data for activation analysis studies was developed. It is automatic, but achieves considerable flexibility by allowing the researcher, who need not be familiar with computers, to direct the progress of the analysis. Hardware and software form an integrated system which allows the construction and maintenance of a library of standards, acquires and manipulates data under user control, and performs the calculations for quantitative analysis of trace element concentrations. (auth)

42713 COMPARISON OF INFRARED AND ACTIVATION ANALYSIS RESULTS IN DETERMINING THE OXYGEN AND CARBON CONTENT IN SILICON. Gross, Chris (Langley Research Center, Hampton, Va.); Gaetano, Gianni; Tucker, T. N.; Baker, J. A. J. Electrochem. Soc.; 119: No. 7, 926-9(Jul 1972).

The oxygen and carbon contents of several silicon single crystals were measured using ^{3}He activation techniques and are compared with values determined from infrared absorption measurements. The oxygen and carbon contents of these crystals as determined from the activation analysis ranged from <0.05 to 28 ppM and <0.05 to 7 ppM, respectively. The infrared absorption measurements gave results that agreed with the activation analysis to within ~40%. (auth)

Chemical and Spectral Procedures

42714 (SGAE-2008) DETERMINATION OF THE ^{90}Sr CONTENT IN COATED PARTICLES BY THE ISOTOPIC DILUTION METHOD. Pichlmayer, F.; Schmid, A. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Mar 1972. 4p. (PH-116/72). Dep. NTIS (U. S. Sales Only).

Studies are being made to determine whether the mass spectrometric isotope dilution method is applicable to determination of fission product (particularly ^{90}Sr) concentration profiles in coated particles. It was found that the relative detectability of Sr in bulk material is only about 10 ppM. The determination of

^{90}Sr in coating layers is therefore not possible without use of a preconcentration technique. (M.C.G.)

42715 SPECTROPHOTOMETRIC DETERMINATION OF CERIUM(IV) IN THE FORM OF A PEROXIDE COMPLEX IN THE UV REGION. Shukurov, S. Sh.; Shemyakin, F. M.; Salakhutdinov, U. I. (Tadzhik Medical Inst., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 1, 31-4(1972). (In Russian).

The method of Ce determination as a peroxide complex in the near uv portion of the spectrum is quite sensitive with an absorption maximum at 300 to 320 nm and a molar absorption coefficient of about 5,920. The variant employed here consisted of adding an ammoniacal solution of Complexon-III and H_2O_2 to the Ce solution at a pH of 10.5, the optical density was measured at 335 and 364 nm. Ce(IV) was thus successfully determined in the presence of Ca, Zn, Pb, Mn, La, Pr, and nitrate ions. (K.S.W.)

42716 JANUS GREEN AS A REAGENT FOR THE EXTRACTION–PHOTOMETRIC DETERMINATION OF TELLURIUM. Guseinov, I. K.; Bagbanly, I. L.; Bagbanly, S. I.; Rustamov, N. Kh. (Inst. of Inorganic and Physical Chemistry, Baku). Dokl. Akad. Nauk Azerb. SSR; 27: No. 5, 29-33(1971). (In Russian).

A tellurium complex is formed under suitable conditions by the reaction of $TeBr_6^{2-}$ with the dye Janus Green, and may be extracted by a 1 : 2 mixture of benzene and acetone. The molar ratio of $TeBr_6^{2-}$ to dye = 1 : 2, and the molar absorption coefficient = 1.2×10^4. Within the limits of concentration of Te of 5 to 35 μg Te/5 ml H_2O, the color of the extract obeys the colorimetric law. (K.S.W.)

42717 ATOMIC-ABSORPTION DETERMINATION OF IRON IN SALTS OF LITHIUM, RUBIDIUM, CESIUM, INDIUM, AND GALLIUM. Yudelevich, I. G.; Kustas, V. L.; Poleva, G. V. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 9, Ser. Khim. Nauk; No. 4, 96-101 (Jul 1971). (In Russian).

An atomic absorption method is proposed for the determination of Fe in various salts of lithium, rubidium, cesium, indium, and gallium. The influence of Li, Rb, Cs, In, Ga, and of hydrochloric, nitric, sulfuric, hydrobromic, hydriodic, hydrofluoric, boric, phosphoric, acetic, lactic, formic, oxalic, citric, and tartaric acids on the absorption of iron in the flame was studied. (auth)

42718 INDIRECT VOLTAMMETRIC DETERMINATION OF POTASSIUM AND CESIUM AND DIRECT AMPEROMETRIC DETERMINATION OF POTASSIUM WITH TETRAPHENYL BORATE BY USE OF SILICONE RUBBER–GRAPHITE ELECTRODES. Siska, Elemer; Pungor, Erno. Magy. Kem. Foly.; 78: No. 4, 175-9(Apr 1972). (In Hungarian).

The electrochemical oxidation of tetraphenyl borate ions was investigated with the help of silicone rubber–graphite electrodes. An indirect voltammetric method for determination of potassium and cesium and a method for determination of potassium with sodium tetraphenyl borate using amperometric end point indication were developed. The amperometric method is more precise. The relative standard deviation is ±0.85%. (tr-auth)

42719 COMPUTER-CONTROLLED MASS SPECTROMETER SYSTEM. Delmore, J. E. Jr. (Idaho Nuclear Corp., Idaho Falls). Chem. Instrum.; 3: No. 3, 251-7(1972).

A computer was incorporated as the main control element in two thermal ionization mass spectrometers used for the routine isotopic analysis of uranium. The operational logic is contained in the software, rather than in the hardware, providing broad versatility in the implementation of operational modes, and greatly simplified hardware. An operational mode was developed, which was optimum for the particular mass spectrometer and the type of sample to be analyzed. The system was used for the analysis of over 1600 samples in the first 10 months of operation, and has proved its value in reduced manpower requirements and improved quality control. (auth)

42720 MEASUREMENT OF OXYGEN SATURATION CONCENTRATION IN SODIUM WITH THE EMF (ELECTROMOTIVE FORCE) METHOD. Borgstedt, H. U.; Marin, A.; Peric, Z.; Wittig, G. (Institut fuer Material- und Festkoerperforschung, Karlsruhe, Ger.). Atomwirt. Atomtech.; 17: No. 7, 361-2(Jul 1972). (In German).

For technical application, a liquid metal oxygen meter was developed. The solid electrolyte, separating the two electrodes of different oxygen partial pressures, was immersed into a mixture of sodium and sodium oxide. The temperature was measured with a thermoelement. The electromotive force was measured with a high-resistance digital voltmeter. At oxygen concentrations above 10 ppM in weight and at temperatures below 350°C, discrepancies occurred between theoretical values and experimental data. Within these limitations, practical application of the method in technical installations should be possible. (H.B.G.)

Radiometric and Radiochemical Procedures

Refer also to abstracts 43006, 43053, and 43097.

42721 (BARC–597) STUDIES ON THE ACTIVATION OF UO_2^{++} ON QUARTZ BY THE FISSION TRACK METHOD. Vishwanathan, K. V.; Iyengar, K. N.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 20p. Dep. NTIS (U. S. Sales Only).

Counting of induced track density following neutron irradiation provides an extremely sensitive method of determining trace amounts of uranium in minerals. This method was applied to study the adsorption of uranyl ions on quartz. The variation in track density on different sites of quartz clearly indicated the heterogeneous nature of the quartz surface. The adsorption of UO_2^{2+} on quartz surfaces at different pH values was found to be the L2 type of Giles. (auth)

42722 (MLM–1901) INVESTIGATION INTO THE DETERMINATION OF PLUTONIUM IN SOIL BY A FUSION PROCEDURE. Gillette, R. K.; Curtis, M. L.; Nunn, E. B.; Frye, J. O.; Bishop, C. T. (Mound Lab., Miamisburg, Ohio). 15 Jun 1972. Contract AT-33-GEN-53. 26p. Dep. NTIS.

A method for the determination of plutonium in soil is discussed. The method involves complete dissolution of the soil by a fusion technique followed by chemical separation of the plutonium, electrodeposition, and alpha pulse height analysis. Results are given for analyses of a spiked soil sample and four soil samples previously analyzed by a procedure in which the plutonium is acid-leached from the soil. The analysis of the spiked soil indicated good accuracy and precision of the fusion method. The results of the analyses of the four soil samples indicated agreement with the leaching results, but indicated that the plutonium was probably not uniformly distributed in the soil. (auth)

42723 RAPID METHOD OF DETERMINING ^{90}Sr, ^{89}Sr, and ^{91}Y IN AEROSOL SAMPLES. Yushkan, E. I.; Rovinskii, F. Ya.; Stukin, E. D.; Iokhel'son, S. B.; Tsybul'nik, G. S. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 895-8(1971).

Translated from Radiokhimiya; 13: No. 6, 872-5(1971).

A rapid method was developed for the simultaneous determination of ^{90}Sr, ^{89}Sr, and ^{91}Y in aerosol samples. The chemical treatment of the samples, collected on filter material, is described. A scintillation β spectrometer was used for measurements on the isolated preparations. (J.G.B.)

42724 USE OF THE METHOD OF COINCIDENCES OF X-RAY AND γ QUANTA FOR THE ANALYSIS OF MIXTURES OF RADIOISOTOPES. Rodin, N. N.; Dembrovskii, M. A. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 899-902(1971).

Translated from Radiokhimiya; 13: No. 6, 875-9(1971).

A method of coincidences of x rays and γ quanta was developed for the identification and quantitative determination of isotopes experiencing electron capture or internal conversion of one of the cascades of γ quanta, using a "Lena" scintillation spectrometer. The possibility of using this method for selective and sensitive analysis of isotopes against a background of interfering radiation without radiochemical separation was demonstrated with the system ^{65}Zn + ^{59}Fe, ^{65}Zn + ^{60}Co, ^{131}Ba + ^{54}Mn, and ^{175,181}Hf + ^{95}Zr as examples. (auth)

42725 NITROGEN DETERMINATION IN BIOLOGICAL SAMPLES USING THE NUCLEAR TRACK TECHNIQUE. Carpenter, B. S.; LaFleur, P. D. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 118(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42726 DETERMINATION OF ^{222}Rn CONCENTRATION IN HOT SPRING WATERS USING A SCINTILLATION CHAMBER. Kobal, I.; Kristan, J. (Univ., Ljubljana, Yugoslavia). Radiochem. Radioanal. Lett.; 10: No. 5, 291-5(30 Jun 1972).

Radon is expelled with nitrogen from water samples and collected at –196°C. Carbon dioxide, hydrogen sulfide, and water vapor are removed previously. The activity of radon is measured in an α scintillation chamber. (auth)

42727 APPLICATION OF GAS CHROMATOGRAPHY FOR THE ANALYSIS OF TRACE AMOUNTS OF VOLATILE ^{75}Se METABOLITES IN EXPIRED AIR. Vlasakova, V. (Institute for Biological Research, Prague); Benes, J.; Parizek, J. Radiochem. Radioanal. Lett.; 10: No. 5, 251-8(30 Jun 1972).

A method is described for determination of trace amounts of volatile organic selenium compounds expired by living organisms after injection of sodium selenite. In the expired air two metabolites of selenium, viz. dimethyl selenide and dimethyl diselenide, were identified. The present method utilizes gas chromatography and radioactive ^{75}Se. (auth)

42728 PROBLEMS OF PLUTONIUM MEASUREMENT IN THE ENVIRONMENT. Healy, J. W. (Los Alamos Scientific Lab., N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 219-23(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Some of the measurement methods now in use, particularly for quantities of plutonium that may escape to the environs, are outlined. (M.C.G.)

42729 MEASUREMENT OF SURFACE CONTAMINATION USING OXYGEN-ION-INDUCED X RAYS. Saltmarsh, M. J.; van der Woude, A.; Ludemann, C. A. (Oak Ridge National Lab., Tenn.). Appl. Phys. Lett.; 21: No. 2, 64-7(15 Jul 1972).

X rays induced by 20-MeV oxygen ions were used to search for trace quantities of lanthanum on the surface of a NaCl crystal. The results demonstrate the sensitivity of the method to small quantities of heavy elements present on low-Z matrices. (auth)

Separation Procedures

Refer also to abstract 42810.

42730 (BARC-606) SUITABILITY OF K^+ BENTONITES FOR THE REMOVAL OF Cs^+ AND Sr^{++} IONS. Brat, Satya; Balu, K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 11p. Dep. NTIS (U. S. Sales Only).

The naturally occurring bentonites (viz. Bihar bentonite, Rajasthan bentonite, and Saurashtra bentonite) of Indian origin were converted to the potassium form by continuously boiling these bentonites with 1M KCl solution in a pyrex glass flask at evolution temperature and atmospheric pressure for a period of 40 days. The converted K^+ bentonites were studied for their various mineralogical and sorptive properties using Cs^+ and Sr^{2+}. These converted K^+ bentonites were found quite suitable for the uptake of Cs^+ and Sr^{2+} ions. (auth)

42731 INFLUENCE OF THE STRUCTURE OF AROMATIC ORGANOPHOSPHORUS ACIDS ON THEIR EXTRACTION PROPERTIES. Laskorin, B. N.; Buchikhin, E. P.; Shatalov, V. V.; Ponomareva, S. I. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 835-9(1971).

Translated from Radiokhimiya; 13: No. 6, 809-15(1971).

The values of the extraction constants of U(VI) for a number of aromatic organophosphorus acids were determined, and it was established that their extraction properties are described by the correlation equation $\lg \tilde{K}_{UO_2^{2+}} = 3.40 - 2.06\ \Sigma ph$. It was found that the peculiarities of the behavior of organophosphorus acids during extraction can be explained on the basis of the concept of the inductive and resonance influences of the radicals connected to the phosphorus atom. (auth)

42732 SEPARATION OF NEPTUNIUM AND PLUTONIUM BY AN ADSORPTION METHOD ON THE SURFACE OF POLISHED PLATINUM. Samartseva, A. G.; Zhuravleva, Z. A. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 882-4(1971).

Translated from Radiokhimiya; 13: No. 6, 857-60(1971).

A new adsorption method was developed for the isolation of trace amounts of plutonium without a carrier on the surface of polished platinum with a yield equal to 99.9 ± 0.1%. This method can be used in the analytical chemistry of this element. An essentially new method of separation of neptunium and plutonium by adsorption of one of the components on the surface of polished platinum was developed. (auth)

42733 SEPARATION OF URANIUM FROM CERTAIN ACCOMPANYING ELEMENTS BY COPRECIPITATION WITH HYDROXIDES. Novikov, A. I.; Gordeeva, L. N. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 907-10(1971).

Translated from Radiokhimiya; 13: No. 6. 883-6(1971).

The coprecipitation of U(VI) and ^{91}Y, ^{144}Ce, ^{106}Ru + ^{106}Rh, ^{114m}In, ^{65}Zn, Ga, Al, ^{204}Tl, ^{99}Mo, ^{75}Se, and Th with Fe(III), Zr, Mn(IV), and Mg hydroxides in the presence of uranium was investigated experimentally as a function of the pH of the medium in 1M ammonium nitrate and when ammonium bicarbonate or hydrogen peroxide is added. The regions of pH of the separation of Th from U were found by the method of coprecipitation with hydroxides: 3.7 to 3.8 for Fe(III) hydroxide, 8.0 to 10.3 for Fe(III) hydroxide in a solution containing hydrogen peroxide, ammonium nitrate, and hydrocarbonate; pH = 12.6 (2 M with respect to NaOH) with Mg hydroxide in the presence of hydrogen peroxide. The regions of separation of uranium (VI) from ^{91}Y, ^{144}Ce, ^{106}Ru + ^{106}Rh, ^{114m}In, ^{65}Zn, Ga, Al, ^{204}Tl, ^{99}Mo, and ^{75}Se were established. (auth)

42734 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF THE EXTRACTION OF URANYL NITRATE BY TRIALKYL PHOSPHATES IN INERT SOLVENTS. VIII. TRI-n-NONYL PHOSPHATE (TNP). Komarov, E. V.; Shpunt, L. B. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 919-21(1971).

Translated from Radiokhimiya; 13: No. 6, 893-5(1971).

The structure $UO_2(NO_3)_2 \cdot 2TNP$ was established. The thermodynamic equilibrium constants of the extraction of uranyl nitrate by solutions of trinonyl phosphate in carbon tetrachloride and n-decane were determined at the temperatures 10 to 50°C. The thermodynamic functions, ΔH, ΔG, and ΔS were determined according to the temperature dependence of the equilibrium constants of the extraction reaction. (auth)

42735 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF THE EXTRACTION OF URANYL NITRATE BY TRIALKYL PHOSPHATES IN INERT SOLVENTS. IX. TRI-n-DECYL PHOSPHATE (TDP). Shpunt, L. B.; Komarov, E. V.; Pushlenkov, M. F. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 922-4(1971).

Translated from Radiokhimiya; 13: No. 6, 895-7(1971).

The structure of the solvate $UO_2(NO_3)_2 \cdot 2TDP$ was established. The thermodynamic equilibrium constants of the extraction of uranyl nitrate by solutions of tri-n-decyl phosphate in carbon tetrachloride and n-decane were found at the temperatures 10 to 50°C. The thermodynamic functions of the extraction reaction were found at $t = 25°C$; ΔH, ΔG, and ΔS. (auth)

42736 INVESTIGATION OF THE SORPTION OF RADIORUTHENIUM BY CERTAIN MINERALS. Spitsyn, Vikt. I.; Grinberg, L. L. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 823-7(1971).

Translated from Radiokhimiya; 13: No. 6, 797-802(1971).

The sorption of radioruthenium by natural sorbents was investigated. Tests of 56 samples established that carbonate minerals and individual representatives of other mineral classes (hematite, pyrolusite) showed high values of sorption with respect to solutions in which ruthenium was present in the form of positively charged particles. It was found by methods of ion exchange and electrodialysis that positively charged particles predominate in solutions of pure compounds of radioruthenium (nitrate and nitrosonitrate). A solution of ruthenium malate consists primarily of anionic complexes. The sorption of radioruthenium is due to interaction of the negatively charged surface of the sorbent with the positive particles of radioruthenium in solution. (auth)

42737 INFLUENCE OF THE NUCLEOPHILICITY OF ANION-LIGANDS ON THE EXTRACTION OF SALTS OF METALS BY SALTS OF AMINES. Shmidt, V. S.; Shesterikov, V. N. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 840-5(1971).

Translated from Radiokhimiya; 13: No. 6, 815-21(1971).

In the extraction of certain tetravalent actinide elements a correlation was observed between the values of the extraction constants of metal salts of the "rigid acid" type by like amine salts and the parameters of nucleophilicity (H) of the anions of these salts. The presence of a linear relationship between the logarithms of the extraction constants of Pu(IV) by solutions of tri-n-octylamine from solutions of HCl, HBr, and HNO_3 and the parameters H of the anions of these acids was established. It was hypothesized that the scale of parameters H can be used for a qualitative (and in certain cases also quantitative) prediction of the relative ability of salts of metals of the type of "rigid acids" to be extracted by amine salts in systems with various anion-ligands. The nature of the dependence of the distribution coefficient of the metal between a solution of acid and a like amine salt on the concentration of the acid in aqueous solution can be estimated qualitatively on the basis of data on the nucleophilicity of the anions (according to the H scale), the basicity of the amine, and the solvating ability of the diluent. (auth)

42738 SYNTHESIS OF SELECTIVE EXTRACTANTS. Zolotov, Yu. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Izv. Sib. Otd. Akad. Nauk SSSR, No. 9, Ser. Khim. Nauk; No. 4, 3-10(Jul 1971). (In Russian).

Methods of preparation of selective extractants for the nonferrous metal industry are considered. Attention is paid to the necessity of ensuring an optimal combination of properties of the metal ion and the extractant (interaction energy, stereochemical requirements, ratio of charges, etc.). For some transition metals and especially metals with a completed d-shell the use of sulfur-containing extractants is of great importance. Zn, Ni, Co, Ru, Mo, W, and U(VI) are among the metals considered. (auth)

42739 EXTRACTION OF A NUMBER OF ELEMENTS BY DIBUTYL THIOPHOSPHORIC ACID FROM NITRIC ACID SOLUTIONS. Artyukhin, P. I.; Startseva, E. A.; Kotlyarevskii, I. L.; Bobrova, Z. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 9, Ser. Khim. Nauk; No. 4, 131-3(Jul 1971). (In Russian).

Data on extraction of a number of elements (including Sc, Sr, Y, Zr, Nb, Mo, Tc, Ru, Te, Cs, La, and Pa) by dibutyl thiophosphate acid (DBTPhA) from nitric acid are given. The possibility of using DBTPhA for both the group separation of elements and the separation of the elements from each other is discussed. (auth)

42740 THERMODYNAMICS OF ION EXCHANGE ON SULFONATED STYRENE–DIVINYLBENZENE COPOLYMERS. XV. SELECTIVITY AND HEATS OF EXCHANGE OF IONS OF THE ALKALINE-EARTH METALS. Soldatov, V. S.; Kuvaeva, Z. I.; Matyukevich, G. V. (Inst. of General and Inorganic Chemistry, Minsk). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 56-8 (Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 102-5(Jan 1972).

Investigations were made of the selectivity and the heats of exchange of alkaline earth metal ions, Mg^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+}, for hydrogen and lithium ions on a sulfonated copolymer of styrene and 8% of p-divinylbenzene at 25°C and the swelling of the exchanger in the mixed $1^{2+}-1^{+}$ forms was also studied. The molal exchange constants were calculated. The swelling varies linearly with the composition of the resin. A sharp increase in selectivity and a decrease in the heats of exchange are observed at high contents of the bivalent ion in the exchanger. (auth)

42741 EXTERNAL DIFFUSION KINETICS OF ION-EXCHANGE SORPTION IN NON-AQUEOUS SOLUTIONS. Tkachenko, P. T.; Shiryaev, V. K.; Bessonov, V. A.; Kasperovich, A. I. (Physical-Technical Inst., Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 47-9(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 85-8(Jan 1972).

The rate of exchange of I^- ions between AV-17 × 8 anion-exchange resin in the OH-form and KI solutions in methanol, ethylene glycol, and their mixtures was investigated by a short-bed method. The variation of the kinetic coefficient (β) with the flow rate of the solution (u), the viscosity (ν), and the mutual diffusion coefficient ($D_{eff}^{0.7}$) is satisfactorily described by the formula $\beta \cong u^{0.47}D_{eff}^{0.7}\nu^{-0.17}$. The boundary diffusion layer is then analogous to that which obtains for laminar flow past a plate: $\delta \cong D_{eff}^{0.3}\nu^{0.17}u^{-0.47}$. (auth)

42742 CRITERION OF THE EFFECTIVENESS OF SEPARATION AND THE RESOLVING POWER OF THE METHOD OF ZONE ELECTROPHORESIS. Stepanov, N. D.; Shalinets, A. B.; Stepanov, A. V. (Leningrad Technological Inst.). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 38 40(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 70-3(Jan 1972).

A criterion has been proposed for the estimation of the effectiveness of the separation of mixtures of elements by electrophoresis in solutions of complex-forming substances. The resolving power of zone electrophoresis on a porous filler is determined not only by diffusion but also by the scatter of the paths traversed by ions on collision with the particles of the porous medium. (auth)

42743 KINETICS OF THE DESORPTION OF HAFNIUM AND ZIRCONIUM FROM KU-2 CATION-EXCHANGE RESIN WITH SULFURIC ACID. II. KINETICS OF THE DESORPTION OF ZIRCONIUM. Grinberg, A. N.; Vinarov, I. V.; Kushnirskaya, E. I. (Inst. of General and Inorganic Chemistry, Odessa). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 19-21(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 34-7(Jan 1972).

The study of the dependence of the kinetics of the desorption of zirconium by 1N sulfuric acid on a number of external parameters and the application of the method of "interruptions" demonstrated that during the initial period the process is determined by internal diffusion and then shifts to the mixed region. The internal diffusion coefficients were obtained from the equations of Patterson and Boyd. The temperature coefficients and activation energies for the desorption of zirconium were calculated. (auth)

42744 ADSORPTION OF INORGANIC COMPOUNDS BY ACTIVATED CARBON. Sigworth, E. A.; Smith, S. B. (Westvaco Corp., Covington, Va.). J. Amer. Water Works Ass.; 64: No. 6, 386-91 (Jun 1972).

Results of tests performed for other reasons were extrapolated to cleansing water supplies and it was concluded that activated carbon, under appropriate conditions of pH, can do a proper job of purification. Elements studied include: Zr, Mo, I, Sb, As, Bi, Cr, Sn, Ag, Hg, Pb, Ni, Ti, V, Fe, Cu, Cd, Zn, Be, Ba, Se, Mn, W, P, Cl, Br, and F. (M.C.G.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 43473.

Chemical and Physico-chemical Properties

Refer also to abstracts 42760, 42825, 42833, 42836, 43626, and 44410.

42745 CHELATE FORMATION OF RIBOFLAVINE WITH ALUMINUM(III), CHROMIUM(III), BERYLLIUM(II), LEAD(II), AND URANIUM(VI). Nayan, Ram; Dey, Arun K. (Univ. of Allahabad, India). Indian J. Chem.; 10: No. 1, 109-12(Jan 1972).

The chelating behavior of 7,8-dimethyl(ribo-2,3,4,5-tetrahydroxypentyl)isoalloxazine (riboflavin) was studied with the metal ions, aluminum(III), chromium(III), beryllium(II), lead(II) and uranium(VI) using the Bjerrum–Calvin pH-titration technique, at 30°C and at ionic strengths of 0.05, 0.1, and 0.2M adjusted by the addition of KNO_3. Thermodynamic stability constants were obtained by extrapolation of log K to zero ionic strength. Logarithms of the overall stability constants (log $K_{\mu=0}$) are: 9.95 for H; 24.40 for Al; 23.10 for Cr; 14.30 for Be; 10.62 for Pb; and 16.55 for U chelates. The corresponding free energy changes ($\Delta F°$) are −12.89, −34.05, −32.24, −19.96, −14.83, −23.09 kcal $mole^{-1}$, respectively. (auth)

42746 TELLURIUM. Cooper, W. Charles. New York; Van Nostrand Reinhold Company (1971). 448p. $22.50.

The history and occurrence, extractive metallurgy, physical and chemical properties, and principal applications of tellurium are covered. Chapter headings include: history and occurrence of tellurium, extractive metallurgy of tellurium, physical properties of tellurium, inorganic chemistry of tellurium, organic compounds of tellurium, analytical chemistry of tellurium, toxicology of tellurium and its compounds, tellurides for thermoelectric applications, tellurium as a free-machining agent in steels, other metallurgical applications, and miscellaneous applications of tellurium. A separate abstract was prepared for one paper. (M.C.G.)

For abstracts of individual chapters see: 42690.

42747 VALUE OF SCHEMES IN SCIENTIFIC THEORY. Gell-Mann, Murray (California Inst. of Tech., Pasadena). pp 317-25 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

Preliminary phenomenological schemes for arrangements of facts in science are discussed and some examples are given. (M.C.G.)

42748 EVOLUTION OF IODINE FROM $NaI–Na_2O_2$ SYSTEM. Lee, Sang Hoon (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 2, 109-15(Jun 1972).

The evolution of radioiodine ^{131}I from a sodium peroxide system as a function of time, temperature, and carrier gas (nitrogen) flow rate was studied. Virtually no iodine was volatilized at 250°C and a very small amount, of the order of 10^{-3}% per hour, at 630°C. Substantially greater amounts of iodine were volatilized at 725 and 830°C. The data are consistent with the hypothesis that the mechanism of transfer is distillation of sodium iodide, and that elemental iodine is not produced in this system. (auth)

Isotope Effects

Refer also to abstracts 42837 and 43586.

42749 ISOTOPIC EXCHANGE OF IODINE WITH THE TRIIODOTRIAMMINEPLATINUM ION. Kukushkin, Yu. N.; Kuz'mina, M. A.; Sibirskaya, V. V. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 947-9(1971).

Translated from Radiokhimiya; 13: No. 6, 914-16(1971).

In a study of the isotopic exchange of iodine in $[Pt(NH_3)_3I_3]I$, the kinetic nonequivalence of sterically nonequivalent iodine atoms contained in the complex ion was demonstrated. The different rate of isotopic exchange on the coordinates I–Pt–I and NH_3–Pt(IV)–I is explained by the different values of the transinfluence of ammonia and iodine. The results of experiments on the isotopic exchange of iodine in $[Pt(NH_3)_3I_3]I$ once again confirmed a rib structure of the indicated compound. (auth)

42750 DEUTERIUM ISOTOPE EFFECTS ON DEGRADATION OF HYDROCORTISONE IN AQUEOUS SOLUTION. Pitman, Ian H.; Higuchi, T.; Alton, M.; Wiley, R. (Univ. of Kansas, Lawrence). J. Pharm. Sci.; 61: No. 6, 918-20(Jun 1972).

C-21-Dideuteriohydrocortisone (I) was synthesized and its stability against degradation in aqueous solution under both aerobic and anaerobic conditions was determined and compared with that of hydrocortisone (II). At pH values between 9 and 13, I was significantly more stable than II when oxygen and 0.1% disodium edetate were present but it appeared to degrade more rapidly than II when oxygen was excluded from the system. At pH 7 and 35°C, both I and II were stable during 96 days in the presence of air and 0.1% disodium edetate but they did degrade slowly when the disodium edetate was excluded. Under these latter conditions, I was again more stable than II. A possible explanation for the enhanced stability of I over II under oxidative conditions is that the reaction path for these degradations involves a rate-determining enolization in the C-17-dihydroxyacetone side chain. (auth)

42751 INVERSE HYDROGEN ISOTOPE EFFECTS IN SOME METAL HYDRIDE SYSTEMS. Wiswall, R. H. Jr.; Reilly, J. J. (Brookhaven National Lab., Upton, N. Y.). Inorg. Chem.; 11: No. 7, 1691-6(Jul 1972).

Several instances were found of metal hydrides in which replacement of hydrogen by deuterium or tritium resulted in a more stable compound. The experimental evidence consists in measurements of the dissociation pressures of pure isotopic species, and of the equilibrium distribution of hydrogen isotopes between gas and solid phases in systems of mixed isotopic content. Examples are VH_2, NbH_2, $(V, Nb)H_2$, and $LaNi_5H_6$. On the other hand, ternary hydrides formed by the intermetallics Mg_2Ni and TiFe exhibit an isotope effect that is in the opposite, and more usual, direction. (auth)

42752 ISOTOPE EFFECTS FOR THE BASE-PROMOTED DEHYDROCHLORINATION OF DDT IN PROTIC SOLVENTS. EVIDENCE FOR ElcB ELIMINATION. McLennan, D. J.; Wong, R. J. (Univ. of Auckland, New Zealand). Tetrahedron Lett.; No. 28, 2887-90(Jul 1972).

Primary deuterium isotope effects were measured for the dehydrochlorination of DDT by a variety of anionic bases in ethanol, and by methoxide ion in methanol. It was found that the isotope effect clearly rises to a maximum and then decreases as the base strength is increased. (UK)

42753 THEORETICAL EVALUATION OF EXPERIMENTALLY OBSERVED ISOTOPE EFFECTS. Wolfsberg, Max (Univ. of California, Irvine). Accounts Chem. Res.; 5: No. 7, 225-33(Jul 1972).

The theory was developed for isotope effects on gas-phase equilibrium constants. It may be used to interpret experimental results in order to obtain information about the energy levels corresponding to the potential energy surfaces on which molecules move. This theory may also be applied to the consideration of isotope effects on the vapor pressure of condensed phases and of isotope effects on reaction rates. Isotope effects in vibrational spectroscopy, on chemical equilibria in the gas phase, on vapor pressure, and on reactions are discussed. (M.C.G.)

42754 FORCE CONSTANTS IN METHYLAMINE: A DETERMINATION BY THE USE OF ^{15}N ISOTOPE SHIFTS. Hirakawa, Akiko Y.; Tsuboi, Masamichi; Shimanouchi, Takehiko (Tokyo Univ.). J. Chem. Phys.; 57: No. 3, 1236-49(1 Aug 1972).

The infrared absorption spectrum of methylamine—^{15}N was examined in the gaseous state, and the amounts of ^{15}N isotope shifts were determined for 12 absorption bands of undeuterated methylamine. Force constants in the methylamine molecule were adjusted on the bases of the vibrational frequencies of CH_3NH_2, CH_3ND_2, CD_3NH_2, and CD_3ND_2 and of the ^{15}N isotope shifts of CH_3NH_2 by the method of the least squares. The ^{15}N isotope shifts were found to be useful data for selecting the best set of force constants among several sets that are equally good as far as only the agreement of the observed and calculated frequencies are taken into account. (auth)

42755 MICROWAVE SPECTRUM OF FLUOROGERMANE, GeH_3F AND GeD_3F. Krisher, Lawrence C.; Morrison, John A.; Watson, William A. (Univ. of Maryland, College Park). J. Chem. Phys.; 57: No. 3, 1357-8(1 Aug 1972).

The effects of ^{70}Ge, ^{72}Ge, ^{73}Ge, ^{74}Ge, ^{76}Ge, and D on the microwave spectra of fluorogermane, GeH_3F, were studied to obtain information on dipole moment and structure. (M.C G.)

Isotope Exchange and Isotope Separation

42756 ISOTOPE EXCHANGE OF THIOUREA AND ITS DERIVATIVES WITH ^{35}S. Vulterin, K. (Institute for Biological Research, Prague); Benes, J.; Kolina, J.; Horak, F. Radiochem. Radioanal. Lett.; 10: No. 5, 259-70(30 Jun 1972).

The effect of N-alkyl and N-aryl substitution of thiourea on the rate of sulfur exchange between thiourea derivatives and elementary sulfur (^{35}S) was investigated to develop an exchange method for preparing labeled thiourea compounds. In order to confirm the results, ^{35}S-labeled thiourea and N, N, N′-trimethylthiourea were prepared. (auth)

42757 MEASUREMENT OF THE RELATIVE DIFFERENCE BETWEEN THE MOBILITIES OF ISOTOPE IONS IN ELECTROLYTE SOLUTIONS. Troshin, V. P. (Ioffe Inst. of Physics and Tech., Leningrad). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 40-2(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 74-6(Jan 1972).

It has been shown that in the determination of ϵ (the relative difference between the mobilities) it is necessary to measure the true ionic velocities, i.e., the solution as a whole must be adopted as the reference system. In this connection the data of certain studies are analyzed in which the apparent ionic mobilities were determined, which led to erroneous results in the determination of ϵ. The values of ϵ for the isotopic ions of ^6Li, ^7Li, ^{39}K, and ^{41}K are presented as a function of the concentrations of solutions of LiCl and Li_2SO_4 on the one hand and KCl, KNO_3, and K_2SO_4 on the other, respectively. The effect of ion hydration on the relative difference between the mobilities of isotopic ions was demonstrated. (auth)

Feed Materials Processing

Refer also to abstract 42941.

42758 CO-EXTRACTION OF URANIUM AND THORIUM. Ritcey, G. M.; Lucas, B. H. (Dept. of Energy, Mines, and Resources, Ottawa). J. Metals; 24: No. 4, 39-44(Apr 1972).

Studies were made to find a solvent extraction process for the co-extraction of uranium and thorium, either directly from acid leach solutions or from the ion exchange barrens, and the subsequent recovery of separate fractions of uranium and thorium. Primary and secondary amines were investigated and HNO_3 was evaluated for stripping. A proposed flowsheet is presented. Economics of the process are discussed. (M.C.G.)

Radiation Chemistry

Refer also to abstracts 42801, 42802, 42822, 43226, 43228, 43230, 43236, 43238, 43241, 43243, and 43245.

42759 (EUR–4695, pp 87-96) DETECTION OF IRRADIATED FOODSTUFFS BY MEANS OF ELECTRON SPIN RESONANCE. Progress Report, April–October 1970. Onderdelinden, D.; Strackee, L. (Rijksinstituut voor de Volksgezondheid, Utrecht). From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

Some preliminary results of measurements on the irradiation yield of poly(vinyl chloride), polyethene, polystyrene, and cellophane are communicated. Irradiations were performed both at 77°K and at room temperature, while irradiation dose rates were 0.66, 0.22, and 0.11 Mrad/hr. The irradiation yield of polyethene, polystyrene, and cellophane was found to be smaller than 0.02 spins/100 eV, assuming a hypothetical line width of 10 gauss. Measurements on polyethene at 77°K revealed a broad spectrum with several lines and a free radical yield of the order 0.2 spins/100 eV. For PVC, irradiation yields up to 8 spins/100 eV were found. Furthermore, a strong dose rate effect showed up in these measurements. It may be remarked here that in later measurements this dose rate effect was appreciably smaller. Decay measurements on PVC showed two decay times about 2 days and about 60 days, respectively. Thus far no influence of the ambient atmosphere on the decay time was found. Measurements at intermediate temperatures and with an improved sensitivity of the spectrometer are in preparation. (auth)

42760 (IFA-FR–89) CORRELATION OF SOME CHARACTERISTIC PARAMETERS OF THE WATER IN THE PRIMARY LOOP OF A REACTOR UNDER OPERATING CONDITIONS, EMPLOYING, CHEMICAL, PHYSICOCHEMICAL, AND SPECTROSCOPIC MEANS. Aleksan, Z.; Ionesky, E. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Radiolytic reactions occurring in water as a result of fission products in the presence of, and in the absence of, oxygen are discussed and related to the cooling/moderating water in the VVR-S reactor. The radioactivity of primary loop water in the VVR-S reactor is primarily traceable to stainless steel corrosion products from the body of the reactor. The chemical and gamma spectroscopic techniques used in such a study are outlined, and a number of specific isotopes are discussed. (K.S.W.)

42761 (KR–146) MEETING OF THE NORDIC SOCIETY FOR RADIATION RESEARCH AND RADIATION TECHNOLOGY, 5–7 MARCH 1972, GAUSDAL HOEIFJELLSHOTELL, NORWAY. Abstracts and Papers. (Institutt for Atomenergi, Kjeller (Norway)). 1972. 69p. (CONF-720324).

Forty-four papers and abstracts of papers were presented. Separate abstracts were prepared for the five papers. (D.H.M.)

For abstracts of individual papers see: 42762, 42763, 43239–43241.

42762 (KR–146, pp 9-13) PHOTOACTIVATION OF TRAPPED ELECTRONS. Steen, Harald B. (Norsk Hydro's Inst. for Cancer Research, Oslo).

From third Nordic Society for Radiation Research and Radiation Technology meeting; Gausdal, Norway (5 Mar 1972).

The photoactivation of x-induced trapped electrons in a 1/1 ethylene glycol—water glass at temperatures from 77 to 130°K and the effect of electron scavengers were studied. It appears that the optical absorption spectrum obtained at 77°K consists of two separate components, whereas at 113°K and above only one of these components remains, probably due to dielectric relaxation of shallow traps. The spectrum at 130°K cannot be changed noticeably by thermal or optic bleaching and it is conceivable that the dielectric relaxation of occupied traps is complete at this temperature. The rate of the light-induced decay of trapped electrons is increased significantly by the presence of electron scavengers. The results can be accounted for by a model which implies that the activation of trapped electrons proceeds via an excited state. This is not in accordance with the hypothesis proposed from studies of NaOH glass that the optical activation of trapped electrons occurs directly. (Norway)

42763 (KR–146, pp 21-31) DOSE RATE DEPENDENCE OF MOLEULAR SIZE IN RADIATION INDUCED POLYMERIZATION OF ACRYL AMIDE. Thomassen, J. A. (Institutt for Atomenergi, Kjeller (Norway)).

From third Nordic Society for Radiation Research and Radiation Technology meeting; Gausdal, Norway (5 Mar 1972).

Measurements of degree of polymerization for acrylamide as a function of dose rate were carried out. The results show significant deviations from that predicted by general assumptions about reaction kinetics. The dose rate dependence of mean degree of polymerization is found to be higher than that predicted by the theory, with a negative slope on logarithmic paper equal to 0.78 instead of the predicted 0.5. The mean degree of polymerization was found to have a maximum at a dose rate of 0.25 k rad/min. This is not predicted in the theory given. Whether or not this maximum exists at other acryl amide concentrations than the one used in the present work is of interest. Investigations of this and other relevant problems connected to radioinduced polymerization of acrylamide are being continued. (auth)

42764 (NP–19127) PUBLICATIONS OF THE INSTITUT YADERNOI ENERGETIKI AKADEMII NAUK BSSR. PART V. RADIATION-CHEMICAL PROCESSES. (Papers and Preprints from Russian Journals). (Akademiya Nauk Belorusskoi SSR, Minsk. Institut Yadernoi Energetiki). 1971. 117p. (In Russian). Dep. NTIS (U. S. Sales Only).

Seventeen papers are included in this collection. Separate abstracts were prepared for 9 of the papers. The remaining 8 were previously abstracted for NSA and appeared as: 21: 105, 106, 107; 24: 2208, 2209, 2210; 25: 1947, 18477. (M.C.G.)

For abstracts of individual papers see: 42768–42775, and 42802.

42765 PHOTOCHEMICAL REDUCTION OF URANYL FLUORIDE BY ETHANOL. Kireeva, G. N.; Savel'eva, V. I.; Gromov, B. V. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 937-9(1971).

Translated from Radiokhimiya; 13: No. 6, 906-9(1971).

The photochemical reduction of uranyl fluoride by alcohols was investigated. It was found that the reaction obeys a first-order equation with respect to uranium; the apparent rate constants of this reaction and the activation energy were calculated. The quantum yields of the reaction were measured in the temperature interval +10 to +50°C. (auth)

42766 CHEMISTRY OF ORGANIC FLUORINE COMPOUNDS. XII. RADICAL ADDITION OF TRIMETHYLAMINE AND TRIETHYLAMINE TO TRIFLUOROCHLOROETHYLENE. Liska, F.; Kubelka, V. (Inst. of Chemical Tech., Prague). Collect. Czech. Chem. Commun.; 37: No. 4, 1381-91(Apr 1972).

The reaction of trimethyl- and triethylamine with trifluorochloroethylene induced by γ irradiation (^{60}Co) or uv light was found to yield, by trifluorochloroethylation of the α- and α,α'-positions of the alkyl groups, 4-methyl-1,2,2-trifluoro-1-chloro-4-azapentane and 4-methyl-1,2,2,6,6,7-hexafluoro-1,7-dichloro-4-azaheptane, and 3-methyl-4-ethyl-1,2,2-trifluoro-1-chloro-4-azahexane and 3,5-dimethyl-4-ethyl-1,2,2,6,6,7-hexafluoro-1,7-dichloro-4-azaheptane, respectively. In both cases 1 : 2 telomers were also detected. Secondary reaction products were the amines formed by radical splitting-off of chlorine atoms under the action of trimethyl- or triethylamine. (auth)

42767 RADIOLYSIS OF THE AQUEOUS SOLUTIONS OF SELENOMETHIONINE. Kopoldova, J. (Biological Institutes, Prague); Nemcova, L. Collect. Czech. Chem. Commun.; 37: No. 4, 1089-96(Apr 1972).

5×10^{-3} to 5×10^{-2}M solutions of selenomethionine were irradiated by gradually increased doses of gamma radiation in oxygen, nitrogen and nitrous oxide atmospheres. The values, calculated for rate constants of radiolysis (K) and for initial yields (G_i) have shown that degradation of selenomethionine proceeds as the result of the indirect effect of radiation, predominantly due to OH radicals. The hydrated electrons are scavenged by the selenium atoms without any degradation of the original substance. The main radiation-degradation reactions of selenomethionine include, in addition to deamination reactions, also reactions leading to the cleavage of $-SeCH_3$ and $-CH_3$ groups, as well as recombination reactions, in contrast to radiation-degradation reactions of methionine irradiated under identical conditions. (auth)

42768 USE OF A NUCLEAR REACTOR FOR RADIATION-CHEMICAL INVESTIGATIONS. Krasin, A. K. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 27-8(1968). (In Russian). (NP–19127 (pp 2-3)).

A loop installation is briefly described for conducting radiation chemical experiments in the IRT-2000 nuclear reactor. The applications of both large and small loops are listed: determination of characteristics of chemonuclear elements, study of hydrazine synthesis from ammonia in gaseous and liquid phases, purification of materials from fission fragment activity, radiation-thermal cracking of petroleum derivatives, and radiation polymerization of methyl methacrylate in wood. (K.S.W.)

42769 EXPERIMENTAL LOOP APPARATUS FOR THE IRT-2000 REACTOR AND INVESTIGATION OF THE PROCESSES OF RADIATION CHEMICAL SYNTHESIS. Krasin, A. K.; Petryaev, E. P.; Strelkov, G. I. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 29-38(1968). (In Russian). (NP–19127 (pp 4-13)).

Use of a nuclear reactor for investigating radiation-chemical processes makes it possible to exploit the n,γ radiation of the reactor, the kinetic energy of fission fragments, and the energy of heavy charged particles released by neutron interaction with ^{6}Li and ^{10}Be. Schematic diagrams are presented for four types of loop installations designed for various purposes: hydrazine synthesis in the vapor or liquid phase, radiation-thermal cracking of petroleum products, and general radiation-chemical testing of substances and chemical reactions. (K.S.W.)

42770 RADIATION SYNTHESIS OF HYDRAZINE FROM AMMONIA IN THE GASEOUS PHASE. Dzantiev, B. G.; Nichipor, G. V. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 48-53(1968). (In Russian). (NP–19127 (pp 64-9)).

The mechanism for radiation synthesis of hydrazine may involve six separate reactions which are given. The influence on the overall reaction of various factors are studied: the secondary action of radicals, the contribution of NH particles on the yield of hydrazine, and the "track" effect. The temperature dependence of the G values for NH_3, H_2, and N_2 at 300 and 600°K was explored. (K.S.W.)

42771 KINETICS OF RADIOLYSIS OF AMMONIA IN THE GASEOUS PHASE. Dzantiev, B. G.; Krasin, A. K.; Nichipor, G. V. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 53-7(1968). (In Russian). (NP–19127 (pp 70-4)).

The effects of dose rate, dose, temperature, and pressure were studied in the radiolysis of gaseous ammonia assuming a radical mechanism. Calculations were made by machine using the Runge–Kutta method. (auth)

42772 RADIATION-CHEMICAL SYNTHESIS OF AMINOACIDS. I. CARBOXYLATION OF METHYLAMINE IN AQUEOUS SOLUTION UNDER THE ACTION OF n,γ RADIATION. Zhigunova, L. N.; Petryaev, E. P. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 69-73(1968). (In Russian). (NP–19127 (pp 75-9)).

The results of experimental investigations of glycine, alanine, and lysine yields in aqueous solutions of carbon dioxide-saturated methylamine in relation to methylamine concentration in the range 0.1 to 5.0 mol/l, pH of medium, concentration of N_2O and diphenylamine, and temperature are given. On the basis of the results the methylamine carboxylation process scheme is considered. (auth)

42773 RADIATION-CHEMICAL AMINATION OF UNSATURATED HYDROCARBONS. Dzantiev, B. G.; Lomako, L. T. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 49-53(1968). (In Russian). (NP-19127 (pp 91-5)).

Results are presented of experimental investigations of radiolysis of gaseous mixtures of ammonia with ethylene and propylene. It is shown that aliphatic amines are formed in the system ammonia—ethylene and ammonia—propylene. Kinetics of their accumulation were studied. (auth)

42774 EFFECT OF THE DOSE PARAMETERS ON THE RADIOLYSIS OF AQUEOUS METHANOL. Afanas'ev, A. M.; Bugaenko, L. T.; Byakov, V. M.; Kalyazin, E. P.; Kovaleva, E. P.; Nichiporov, F. T.; Petryaev, E. P. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 23-6(1968). (In Russian). (NP-19127 (pp 99-102)).

The effects of radiation temperature, dose rate, and of LET value on $G(C_2H_6O_2)$ and $G(CH_2O)$ in the radiolysis of a binary mixture of methanol and water is reported. Study of the radiolysis of a binary mixture on methanol and water should make it possible to determine the dose rate and LET value of the n,γ radiation of the nuclear reactor used. (auth)

42775 RADIOLYSIS OF PROPYLENE AND ETHYLENE. Dzantiev, B. G.; Lomako, L. T. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 27-36(1968). (In Russian). (NP-19127 (pp 103-12)).

Results are presented of experimental investigations of γ radiolysis of simple unsaturated hydrocarbons such as ethylene and propylene in the gas phase. Radiation decay kinetics of the reference hydrocarbons and generation of hydrogen and hydrocarbons C_1-C_7 were studied. Results obtained are compared with data reported in the literature on the yields of products, radicals, and ions. Estimations were made of some primary processes and of the possible role of thermal and hot radicals in the mechanism of formation of olefin radiolysis products. (auth)

42776 INVESTIGATION OF THERMOCHEMICALLY TREATED QUARTZ BY OPTICAL AND RADIOACTIVATION METHODS. Vakhidov, Sh. A.; Gasanov, E. M.; Tsinober, L. I.; Gordienko, L. A. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 953-4(1971).

Translated from Radiokhimiya; 13: No. 6, 918-20(1971).

Activation analysis, autoradiography, and thermoluminescence were used to study thermochemically treated and irradiated quartz. The distribution and amounts of Na and K in the crystals were determined. It was found that in the case of thermochemical treatment, ions of the alkali metals do not go beyond the limits of the treated part of the crystal. (M.C.G.)

42777 TRAPPED ELECTRONS PRODUCED BY BIPHOTONIC PHOTOIONISATION AND THEIR RELATION WITH DELAYED EMISSION OF INDOLE RING IN ETHANOL GLASS. Aubailly, M.; Bazin, M.; Santus, R. (Museum National d'Histoire Naturelle, Paris). Chem. Phys. Lett.; 14: No. 4, 422-4(15 Jun 1972).

Trapped electrons are produced by biphotonic ionization of indole in low-temperature absolute ethanol glasses. The D. F. emission of indole in such media occurs via triplet—triplet absorption processes followed by recombination of mobile and detrapped electrons with photoionized chromophores. Mechanisms of the trapping in photolysis, γ radiolysis, and pulse radiolysis are discussed. (M.C.G.)

42778 SPECTRA OF TRANSITORY SPECIES IN THE PULSE RADIOLYSIS OF ALKYL BENZENES. Bensasson, R. V. (Univ., Paris); Richards, J. T.; Gangwer, T.; Thomas, J. K. Chem. Phys. Lett.; 14: No. 4, 430-2(15 Jun 1972).

Pulse radiolysis of o-, m-, and p-xylene, mesitylene, and pseudocumene give rise to three main absorption spectra at about 600, 400, and 320 nm. Those transients might be correlated to an excimer state (600 nm) a biradical (320 nm) a triplet state (400 nm). (auth)

42779 FREE RADICALS IN THE HIGH ENERGY IRRADIATION OF ADAMANTANE. Filby, W. G.; Guenther, K. (Kernforschungszentrum, Karlsruhe, Ger.). Chem. Phys. Lett.; 14: No. 4, 440-1(15 Jun 1972).

The ESR spectrum of an electron-irradiated sample of highly purified adamantane is presented. Arguments are presented for the assignment of the radical and 1-adamantyl. (auth)

42780 ESR OF O_2^- SPECIES ADSORBED ON THERMALLY ACTIVATED MgO POWDERS. Derouane, E. G. (Univ., Liege); Indovina, V. Chem. Phys. Lett.; 14: No. 4, 455-9(15 Jun 1972).

Molecular adsorption of oxygen as O_2^- ions occurs on MgO powders evacuated at 1200 to 1300°K with no need for prior irradiation. Several O_2^- species were observed and related to the presence of various adsorption sites. (auth)

42781 CONTINUOUS CROSSLINKING OF POLY(VINYL CHLORIDE) BY RADIATION. Loan, L. D. (Bell Labs., Whippany, N. J.); Salmon, W. A.; Austin, J. R. Trans. Amer. Nucl. Soc.; 15: No. 1, 167(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42782 INDUSTRIAL APPLICATION OF RADIATION CHEMISTRY IN JAPAN. Tabata, Yoneho (Tokyo Univ.). Trans. Amer. Nucl. Soc.; 15: No. 1, 169(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42783 RADIOLYSIS OF HYDROGEN SULFIDE IN THE PRESENCE OF HYDROGEN BROMIDE. Forys, M. (University Teachers Coll., Siedlce, Poland); Wojciechowski, K. Radiochem. Radioanal. Lett.; 10: No. 5, 271-6(30 Jun 1972).

The effect of HBr on G_{H_2} was studied in irradiated H_2S. An increase in G_{H_2} equal to 3.8 was observed. A possible mechanism is suggested. (auth)

42784 RADIATION SENSITIZATION REACTIONS OF N-ETHYLMALEIMIDE WITH MODEL COMPOUNDS. Hayon, E. (Army Natick Lab., Mass.); Simic, M. Radiat. Res.; 50: No. 3, 464-78(Jun 1972).

The reactions of e_{aq}^-, OH radicals, and H atoms with N-ethylmaleimide (NEM) and N-ethylmaleamic acid (NEMA, which is produced from the hydrolysis of NEM at pH > 7) were investigated in aqueous solutions. The reaction rate constants, the transient optical absorption spectra, and the decay kinetics of the resulting intermediates were obtained. The free radical sensitization reactions of NEM with model compounds were followed by pulse radiolysis. A number of organic free radicals were found to react with NEM by an electron transfer process (oxidation of free radicals) to produce $\cdot NEM^-$, and/or by addition to NEM. NEMA, being a poorer oxidizing agent, does not appear to undergo most of these reactions. Electron adducts (e.g., radical anions of pyrimidine bases) were shown to transfer an electron to NEM. Solutes with redox potentials higher than that of NEM, such as menadione and oxygen, were found to be good electron acceptors from $\cdot NEM^-$. The general implications of these free radical reactions to radiation sensitization are discussed. The nature of the sensitizer and the variety of alternate reaction paths by which sensitizing action can occur are emphasized. (auth)

42785 PULSE RADIOLYSIS STUDIES OF THE OXIDATION OF ASCORBIC ACID BY OH-RADICALS AND HALOGEN RADICAL ANION COMPLEXES IN AQUEOUS SOLUTION. Schoeneshoefer, M. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch.; 27b: No. 6, 649-59(Jun 1972). (In German).

Ascorbic acid is oxidized by the OH radical and by radical anion complexes X_2^- (X: Cl, Br, I, SCN) to yield the ascorbic acid radical, which finally disappears by second order reaction. The pK of this radical was found to be about 3. It has several precursor radicals formed by the addition of OH or X to ascorbic acid. They lose H_2O or HX, respectively, with different rates or are desactivated in radical-radical reactions. The precursor radicals are acids of different pK values. Since ascorbic acid exists in two tautomeric forms in aqueous solution, two precursor radicals are postulated for the reaction of OH with ascorbic acid. They lose water or OH^- at different rates to form the ascorbic acid radical. The absorption spectra of these species were measured. All radicals including the ascorbic acid radical have strong absorption at 3600 Å, although somewhat different extinction coefficients. The decay of the 3600 Å absorption in the 100 μs and millisecond range is partly due to the loss of water of long-lived precursors and to radical-radical desactivation of precursors and the ascorbic acid radical. Earlier conclusions of Bielski et al. about the pK of the ascorbic acid radical and about its protonization could not be confirmed taking into consideration the complex precursor reactions. The kinetics are strongly dependent on the dose below about 400 rad. The precursor radicals formed by the addition of X to ascorbic acid are generally shorter lived than the OH addition precursors. (auth)

42786 SOLVENT EFFECT IN THE OXIDATION OF ALKENYLBENZENES INITIATED BY γ RADIATION. Komarov, P. N.; Baranova, N. M. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 202: No. 3, 629-32(21 Jan 1972). (In Russian).

The liquid-phase oxidation of alkenylbenzenes (isoeugenol, isosafrole, and styrene) was investigated in the absence of a solvent and in acetic acid solution at 23°C. The oxidation was initiated by a γ radiation field of 5.9×10^{15} eV/ml · sec, and further aided by bubbling O_2 through the liquid. Gas—liquid chromatography in addition to chemical methods was used to analyze the reaction products. The oxidation of alkenylbenzenes when initiated by γ radiation in the absence of a solvent was essentially no different from the usual oxidation. In contrast, the oxidation in solution (acetic acid) was altered both in rate, and in its course. (K.S.W.)

42787 PRODUCTS OF THE γ-RADIOLYSIS OF LECITHIN. Goida, E. A. (Donets State Univ., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 133-4(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 225-6(Jan 1972).

The decomposition of lecithin by γ rays is proportional to the radiation dose, but the radiolysis proceeds with a very low quantum yield. Even for a dose of 1000 krad, 15.6% of the lecithin remains undecomposed. The products of the γ radiolysis of lecithin are lysolecithin, fatty and phosphatidic acids, choline, and unidentified polymerization products. The free aliphatic acids fraction of egg yolk lecithin decomposed by γ rays consists of about 30% of unsaturated and about 70% of saturated aliphatic acids. (auth)

42788 KINETICS OF THE DESULFURATION OF THE H-FORM OF KU-2 CATION-EXCHANGE RESINS IN WATER BY SIMULTANEOUS HEAT TREATMENT AND IRRADIATION. Tulupov, P. E.; Butaev, A. M.; Greben, V. P.; Kasperovich, A. I. (Physical-Chemical Inst., Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 74-7(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 137-41(Jan 1972).

The kinetics of the radiation-induced desulfuration of the H-form of KU-2 cation-exchange resin in water follow the equation for a second order reaction with an activation energy of 2.45 ± 0.05 kcal mole^{-1} and a pre-exponential factor of 3.39×10^{-9} kg of matrix/mole rad. In the combined radiation- and heat-induced process, the constant for the thermal hydrolysis of the sulfogroups increases under the influence of radiation, the increase being equivalent to a rise of the effective temperature by 3 to 9 deg. An induction period in the desulfuration process during the initial stage of the irradiation of KU-2 resin was established. (auth)

42789 KINETICS OF DISSOLUTION OF STRONTIUM SULFATE IRRADIATED BY FAST ELECTRONS. Parkhaeva, T. N.; Gremov, V. V.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 202: No. 3, 639-41(21 Jan 1972). (In Russian).

The effect of 3.5-MeV electrons on the dissolution rate of strontium sulfate (natural celestite) in water at 25°C was studied. The formation of SO_3^- ion-radicals occurred as defects which accelerated dissolution. This behavior is in contrast to the decelerated dissolution resulting from self-irradiation (^{35}S) or from ^{60}Co gamma irradiation. (K.S.W.)

42790 DECREPITATION PROPERTIES OF POTASSIUM AND AMMONIUM PERSULFATES. Lapshin, A. I.; Serebrennikov, A. I.; Glazunov, O. O. (Inst. of Catalysis, Novosibirsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 28-30 (Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 50-3(Jan 1972).

The decrepitation properties of potassium and ammonium persulfates shown on dissolution in water and on heating were investigated together with the time variation of the decrepitation, the effect of irradiation with ^{60}Co γ rays, and the application of an explosive stress to potassium and ammonium persulfates. The time variation for potassium and ammonium persulfates follows a hyperbolic law. Irradiation with ^{60}Co leads to a decrease and explosive stress to the disappearance of the decrepitation properties of potassium persulfate. (auth)

42791 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF HYDROPHILIC MONOMERS TO POLYESTER. Lee, Chong Kwang; Choi, Jae Ho (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 2, 90-101(Jun 1972).

Radiation grafting of acrylic acid to polyester fabric was studied by an impregnation method to render its surface more hydrophilic. Impregnated fabric was irradiated under nitrogen with ^{60}Co γ rays. The homopolymer formed usually could be extracted with water at 100°C. Graft—fabric exhibited a good acceptability to acid, basic, or disperse dyes in a conventional aqueous dye bath at moderate temperature. (auth)

42792 TERMINATION MECHANISM IN THE PLASTIC CRYSTALLINE STATE POLYMERIZATION OF 1,2-CYCLOHEXENE OXIDE. Hiramoto, Tetsuo; Nishii, Masanobu; Hayashi, Koichiro; Okamura, Seizo (Japan Atomic Energy Research Inst., Osaka). J. Polym. Sci., Part B; 10: No. 7, 511-13(Jul 1972).

A study was made of the termination mechanism of plastic crystalline monomers by determination of the dose dependence of the polymerization rate. 1,2-cyclohexene oxide was exposed to γ radiation at dose rates from 11 to 113 rad/min. The extent of bimolecular termination is a characteristic feature of the plastic crystalline state polymerization. (M.C.G.)

42793 ELECTRON SPIN RESONANCE OF SINGLE CRYSTALS OF CYSTINE DIHYDROCHLORIDE IRRADIATED WITH MONOCHROMATIC UV RADIATION AT VARIOUS WAVELENGTHS. Thomsen, E. Lund; Nielsen, S. O. (Danish Atomic Energy Establishment, Riso). J. Chem. Phys.; 57: No. 3, 1095-9(1 Aug 1972).

Single crystals of cystine dihydrochloride were irradiated at room temperature with monochromatic uv radiation. The optical bandwidth was about 20 Å for each wavelength used. Essentially two ESR centers were observed, the relative yield being approximately 1. One center is identified as the RS radical also detected after γ irradiation at room temperature, the second center is tentatively identified as a RS radical stabilized in an environment different from that of the first mentioned RS radical or alternatively as the RSS^+R radical ion. (auth)

42794 ELECTRON SPIN RESONANCE STUDY OF RADICALS PRODUCED BY THE REACTIONS OF HYDRATED ELECTRONS WITH UNSATURATED ACIDS. Neta, P.; Fessenden, Richard W. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem. ; 76: No. 14, 1957-61(6 Jul 1972).

A search was made for the ESR spectra of radicals formed as the result of e^-_{aq} addition to a number of unsaturated carboxylate anions in irradiated aqueous solutions. The adducts of acrylic and acetylenedicarboxylic acids were found to protonate rapidly on carbon to give the radicals $CH_3\dot{C}HCO_2^-$ and $^-O_2CCH{=}\dot{C}CO_2^-$, respectively. Stable anion radicals were formed from muconic, chelidonic, maleic, and dihydroxyfumaric acids. The acid-base equilibria of these radicals were followed and protonation was found to occur on the carboxyl groups. In the cases of maleic and dihydroxyfumaric acids strong intramolecular hydrogen bonds were formed that resisted dissociation even in 1 M base. (auth)

42795 APPLICATION OF THE SEMICONTINUUM MODEL TO PRESSURE EFFECTS ON SOLVATED ELECTRON SPECTRA IN METHANOL AND ETHANOL. Feng, Da-fei; Fueki, Kenji; Kevan, Larry (Wayne State Univ., Detroit). J. Chem. Phys.; 57: No. 3, 1253-8(1 Aug 1972).

The semicontinuum model for solvated electrons was applied to the calculation of pressure effects on solvated electron spectra in methanol and ethanol at 298°K. The pressure dependence of the density, static, and optical dielectric constants and the quasifree electron energy state were all included. The calculated results satisfactorily explain the experimentally observed blue shifts with pressure. Analysis shows that pressure affects short range interactions much more than long range interactions and results in a decrease in the electron cavity radius and an increase in the energy of the quasifree electron state. (auth)

42796 ELECTRON TRANSFER REACTIONS AND THE OXIDATION POTENTIAL OF SOME LANTHANIDE IONS IN AQUEOUS SOLUTIONS. Tendler, Y.; Faraggi, M. (Israel Atomic Energy Commission, Beersheba). J. Chem. Phys.; 57: No. 3, 1358-9(1 Aug 1972).

Divalent lanthanide ions produced in pulse radiolysis of aqueous solutions of lanthanides were studied to give an estimate of Ln(II)/Ln(III) redox potentials. Nitrite ions were added to the irradiated solutions to oxidize the Ln(II). (M.C.G.)

42797 RADIATION-INDUCED AND ELECTROCHEMICAL FORMATION OF 3-SUBSTITUTED 4,4-DIMETHYL-γ-BUTYROLACTONE FROM α,β-UNSATURATED ESTER. Itoh, Mitsuomi; Taguchi, Toru; Chung, Vo Van; Tokuda, Masao; Suzuki, Akira (Hokkaido Univ., Sapporo). J. Org. Chem.; 37: No. 14, 2357-9 (14 Jul 1972).

The radioinduced addition reactions of 2-propanol and electrochemical reductive addition reactions of acetone to α,β-unsaturated esters are reported. Irradiation of an α,β-unsaturated ester in a tenfold excess of 2-propanol with ^{60}Co γ rays gave the corresponding 3-substituted 4,4-dimethyl-γ-butyrolactone. The electrochemical addition of acetone to an α,β-unsaturated ester gave 4,4-dimethyl-γ-butyrolactone in almost quantitative yield. (M.C.G.)

42798 PREPARATION AND PROPERTIES OF PERFLUOROAMMONIUM TETRAFLUOROBORATE, $NF_4^+BF_4^-$, AND POSSIBLE SYNTHESIS OF NITROGEN PENTAFLUORIDE. Goetschel, C. T.; Campanile, V. A.; Curtis, R. M.; (and others) (Shell Development Co., Emeryville, Calif.). Inorg. Chem.; 11: No. 7, 1694-1701(Jul 1972).

A new crystalline compound, $NF_4^+BF_4^-$, was prepared by exposing the heterogeneous ternary system $NF_3-BF_3-F_2$ to 3-MeV bremsstrahlung at 77°K. The G value for the reaction (molecules isolated per 100 eV absorbed) is about unity. The compound is stable at room temperature in dry air; it decomposes above 250°C to the reactants. It reacts rapidly with moisture and with organic substances. The indicated ionic structure is confirmed by infrared and Raman spectroscopy. The x-ray powder pattern can be indexed on the basis of a tetragonal unit cell with a = 7.01 and c = 5.22 Å. Irradiation of mixtures of nitrogen trifluoride and excess fluorine at 77°K led to isolation in low yields of a white solid. It decomposes below 143°K to liberate nitrogen trifluoride and reacts with boron trifluoride at low temperature to form NF_4BF_4. Its most likely identity is perfluoroammonium fluoride. (auth)

42799 CONCENTRATED ELECTRON SCAVENGER EFFECTS ON THE YIELDS OF TRAPPED SPECIES IN γ-IRRADIATED ALKALINE GLASS. Zimbrick, John D.; Bowman, Michael K. (Univ. of Kansas, Lawrence). J. Phys. Chem.; 76: No. 14, 1962-7(6 Jul 1972).

The γ radiolysis of aqueous alkaline glass at 77°K produces significant yields of solvated electrons, hydrogen atoms, and oxygen radical anions ($O^{\cdot-}$), which are trapped in the glassy matrix. EPR techniques were used to measure the relative yields of these three species as a function of NO_3^- concentration. The yields of trapped hydrogen atoms (H_t) were determined in the absence of NO_3^- as a function of OH^- concentration, ice phase, and radiation dose. The paramagnetic relaxation behavior of H_t was measured as a function of radiation dose and OH^- concentration. The formation of $NO_3^{2\cdot-}$ via e_m^- (mobile electron) scavenging by NO_3^- increased linearly with $[NO_3^-]^{1/2}$ up to a NO_3^- concentration of 0.1 M at which point the slope of the curve decreased and $G(NO_3^{2\cdot-}) = 3.4$. At NO_3^- concentrations above 0.1 M, the yield of $NO_3^{2\cdot-}$ continued to increase linearly up to a G value of 4.9 at 3 M. The $G(H_t)$ was not reduced below the value obtained in the absence of NO_3^- until $[NO_3^-]$ reached concentrations of ≥0.1 M. $G(O^{\cdot-})$ increased linearly with $[NO_3^-]^{1/2}$ until a NO_3^- concentration of 0.1 M was reached. Just as in the case of $G(NO_3^{2\cdot-})$, the $O^{\cdot-}$ yield curve exhibited a negative change in slope at $[NO_3^-] = 0.1$ M, above which $G(O^{\cdot-})$ increased slowly up to $[NO_3^-] = 3$ M. Paramagnetic relaxation measurements indicated that the local concentration of H_t decreased with increasing radiation dose in the same dose region in which the sample-average concentration of H_t increased. All of these data support the hypothesis that a significant fraction of electrons produced in alkaline glass by radiation do not become hydrated before they react in spurs. These electrons can be scavenged by NO_3^- and are responsible for the formation of a major fraction of the observed yield of H_t. (auth)

42800 REACTION OF CYANOGEN RADICALS WITH AMMONIA. Bullock, G. E. (Univ. of Melbourne); Cooper, R.; Gordon, S Mulac, W. A. J. Phys. Chem.; 76: No. 14, 1931-5(6 Jul 1972).

The pulse radiolysis of dilute $C_2N_2-NH_3$ mixtures in argon was used to study the reaction of CN radicals with NH_3 at 300 and 375°K. An increase in the rate constant for CN radical disappearance was observed for radicals with higher vibrational excitation than the ground state. Removal of the ground and fourth vibrational states showed a negative temperature dependence. These results are discussed with respect to the possible roles played by chemical reaction and by vibrational relaxation. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 44320.

42801 GAMMA SPECTRUM ANALYSIS ON TIME-SHARING COMPUTERS. Majteles, Michael (Pacific Gas and Electric Co., Emeryville, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 651-3(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A "matrix" method for analysis of γ spectra utilizing time-sharing computers is described. Its essence is the solution to the matrix equation $\bar{C} = \bar{R}\,\bar{\Phi}$ where $\bar{C}$ is the vector of count rates, $\bar{\Phi}$ is the energy vector of the γ flux, and $\bar{R}$, the response matrix, represents instruments' count rate due to the γ flux impinging on the detector. (M.C.G.)

Hot-Atom Chemistry

42802 EFFECT OF RADIOLYSIS ON STABILIZED FORMS OF ^{35}S AND ^{32}P IN CCl_4 IRRADIATED IN A NUCLEAR REACTOR. Petryaev, E. P.; Solov'eva, G. D.; Mironov, V. P. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 119-21(1968). (In Russian). (NP-19127 (pp 96-8)).

The influence of maternal substance radiolysis on the forms of stabilization of radioactive sulfur and phosphorus isotopes is shown. In the water extract from irradiated carbon tetrachloride all the radioactive sulfur is present in the form of sulfuric acid and radioactive phosphorus present with phosphorite and the trichloromethylphosphonic acid forms a composition similar to red phosphorus. (auth)

42803 METHOD OF ISOLATION OF THE RADIOACTIVE ISOTOPE ^{106}Rh AND ITS HALF-LIFE. Rudenko, N. P.; Kordyukevich, V. O. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 885-9(1971).

Translated from Radiokhimiya; 13: No. 6, 860-5(1971).

A method was developed for the isolation of the short-lived radioactive isotope ^{106}Rh during its formation in the β decay of the parent ruthenium-106, taken in the form of ruthenium diethyl dithiophosphate. The half-life of the radioisotope rhodium-106, equal to 25.7 ± 0.2 sec ($\lambda = 0.0246\ sec^{-1}$), was determined. (auth)

42804 MOESSBAUER STUDY OF THE VALENCE STATE OF ^{119}Sn AFTER EC DECAY OF ^{119}Sb IN ANTIMONY, Sb_2Te_3, AND Sb_2S_3. Ambe, F.; Shoji, H.; Ambe, S.; Takeda, M.; Saito, N. (Inst. of Physical and Chemical Research, Saitama, Japan). Chem. Phys. Lett.; 14: No. 4, 522-4(15 Jun 1972).

^{119}Sn Moessbauer emission spectra of ^{119}Sb-labeled antimony, Sb_2Te_3 and Sb_2S_3 showed the appearance of Sn(0), Sn(II), and Sn(II) + (IV) states respectively in the solids. The results were interpreted in terms of the properties of the matrices. (auth)

42805 HOT ATOM CHEMISTRY. CHEMICAL REACTIONS SUBSEQUENT TO NUCLEAR TRANSFORMATIONS. FRENCH EDITION, ENLARGED AND REVISED. Stoecklin, G. Paris; Masson (1972). 242p. (In French).

Translation of Chemie Heisser Atome.

The physical and chemical effects of nuclear transformations (nuclear reactions with capture and emission of particles (n,γ) reactions, isomeric transition, β decay) are described. The dissipation of energy and the charge state of recoil atoms are given. Reaction models, various theories, and experimental methods concerning the chemical reactions of hot atoms in gaseous and liquid systems were investigated. The hot atom chemistry of tritium, halogens, or C in aliphatic or aromatic systems is reviewed. Chemical reactions induced by the β decay of ^{14}C, ^{3}H, and ^{131}Te in organic systems were studied. The chemical reactions induced by nuclear transformations in mineral solids are reviewed. (France)

Properties of Radioactive Materials

Refer also to abstracts 42721, 42745, 42748, 42756, and 42765.

42806 COPRECIPITATION OF THORIUM WITH HYDROXIDES OF IRON(III), ZIRCONIUM(IV), AND MANGANESE(IV). Novikov, A. I.; Gordeeva, L. N. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 819-22(1971).

Translated from Radiokhimiya; 13: No. 6, 783-97(1971).

The influence of the pH of the medium and salt background on the coprecipitation of thorium with precipitates of Fe(III), Zr(IV), and Mn(IV) hydroxides was investigated experimentally. The coprecipitation of Th and its sorption by the surface of hydroxides begin in the region of hydrolysis of thorium ions, increase with increasing degree of polymerization, and stop entirely when coordination-unsaturated ions of the type of $[Th(CO_3)_5H_2O]^{6-}$ or $[Th(CO_3)_6]^{8-}$, incapable of coordination interaction with the carrier, are formed. The sorption of thorium ions is accompanied by the liberation of protons in solution in a definite interval of pH of the medium. Thorium can be concentrated by coprecipitation with hydroxides in 1M NH_4NO_3 at pH 2 to 14 (Mn hydroxide) and 5 to 14 (Zr hydroxide); in 1M NH_4NO_3 and 0.5M NH_4HCO_3 at pH 2 to 8.5 and >11 (Mn hydroxide); in 1M NH_4NO_3 and 0.5M $(NH_4)_2SO_4$ at pH from 4.5 to 7.0 for Mn, Zr, and Fe hydroxides; in the presence of hydrogen peroxide at pH 4 to 10 (Zr hydroxide). Thorium is separated from Mn hydroxide in all the media studied at pH < 1, as well as at pH about 10 in the presence of bicarbonate ions. (auth)

42807 INVESTIGATIONS OF THE KINETICS OF REDOX REACTIONS OF THE ACTINIDE ELEMENTS. XX. KINETICS AND MECHANISM OF THE INTERACTION OF AMERICIUM(III) AND (V) WITH PEROXYDISULFATE IONS IN NITRIC ACID SOLUTION. Ermakov, V. A.; Rykov, A. G.; Timofeev, G. A.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 851-7(1971).

Translated from Radiokhimiya; 13: No. 6, 826-32(1971).

A mechanism was proposed for the reaction of americium(III), (V), and (VI) with peroxydisulfate ions. The possibility of reduction of americium(VI) in its reaction with peroxydisulfate ions was demonstrated. (auth)

42808 INVESTIGATIONS OF REDOX REACTIONS OF THE ACTINIDE ELEMENTS. XXI. KINETICS AND MECHANISM OF THE INTERACTION OF AMERICIUM(VI) WITH PEROXYDISULFATE IONS IN NITRIC ACID SOLUTIONS. Rykov, A. G.; Ermakov, V. A.; Timofeev, G. A.; Chistyakov, V. M.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 858-61 (1971).

Translated from Radiokhimiya; 13: No. 6, 832-6(1971).

The kinetics of the reaction of americium(VI) with peroxydisulfate ions in nitric acid solutions were studied. A mechanism was proposed, a characteristic feature of which is the presence of competing processes: oxidation of americium(V) and reduction of americium(VI) by products of thermal decomposition of peroxydisulfate ions. (auth)

42809 COMPLEX COMPOUNDS OF THORIUM WITH ORGANIC LIGANDS. Grinberg, A. A.; Petrzhak, G. I.; Lozhkina, G. S. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 862-5(1971).

Translated from Radiokhimiya; 13: No. 6, 836-40(1971).

New complex salts of thorium with organic ligands were synthesized: $K_4[Th(C_6H_5O_7)_2 \cdot C_2O_4] \cdot 3H_2O$, potassium dicitratooxalatothorate, and $K_4[Th(C_4H_4O_6)_2 \cdot (C_2O_4)_2] \cdot 3H_2O$, potassium ditartratodioxalatothorate. Some chemical and physicochemical properties of the isolated compounds were studied. The similarity in the behavior of thorium derivatives and the analogous derivatives of uranium(IV) isolated earlier was demonstrated. A hypothesis was advanced on the chemical mechanism of the interaction of the ligands with the central atom. (auth)

42810 STUDY OF COMPLEX FORMATION BY AN EXTRACTION METHOD. II. COMPLEX FORMATION OF AMERICIUM, CURIUM, CALIFORNIUM, PROMETHIUM, AND EUROPIUM WITH 2-HYDROXYETHYLIMINODIACETEC ACID. Ermakov, V. A.; Vorob'eva, V. V.; Zaitsev, A. A.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 866-8(1971).

Translated from Radiokhimiya; 13: No. 6, 840-3(1971).

The constant for the extraction of europium ($\log K_{ex} = -7.74$) by thenoyltrifluoroacetone in benzene was determined at an ionic strength of 0.1 M and $t = (25 \pm 0.2)°C$. It was established that in the investigated pH region 2-hydroxyethyliminodiacetic acid forms complex ions with americium, curium, californium, promethium, and europium, with the composition $[MeA]^+$. The stability constants of complex ions of americium ($\log \beta_1 = 9.3 \pm 0.1$), curium ($\log \beta_1 = 9.27 \pm 0.06$), californium ($\log \beta_1 = 9.61 \pm 0.08$), promethium ($\log \beta_1 = 8.97 \pm 0.05$), and europium ($\log \beta_1 = 9.61 \pm 0.06$) were determined. (auth)

42811 SPECTROPHOTOMETRIC STUDY OF COMPLEX FORMATION AND SOLVATION OF IONS OF THE ACTINIDE ELEMENTS. III. NEPTUNIUM(IV) IN NITRATE SOLUTIONS. Rykov, A. G.; Blokhin, N. B. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 869-76(1971).

Translated from Radiokhimiya; 13: No. 6, 843-52(1971).

It was established by a spectrophotometric method (measurement of the integral and differential absorption spectra) that neptunium(IV), analogously to uranium(IV), exists in nitrate solutions of medium concentration ($C \leq 5$ M) in only two spectrally distinguishable forms. It was found that the concentrations of the two spectral forms of neptunium(IV) are related to the total concentration of nitrate ions in solution by simple exponential functions. (auth)

42812 OXIDATION OF URANIUM DIOXIDE AT TEMPERATURES BELOW 270°C. Kuz'micheva, E. U.; Kovba, L. M.; Ippolitova, E. A. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 877-81(1971).

Translated from Radiokhimiya; 13: No. 6, 852-7(1971).

In the oxidation of uranium dioxide below 270°, U_4O_9, α-U_3O_7, and the rhombic phase δ-U_3O_7 were not obtained. In the oxidation of uranium dioxide, just as in the case of the oxidation of U_4O_9, the tetragonal oxides β-U_3O_7 and γ-U_3O_7 were formed, then the rhombic phases $U_8O_{21 \pm x}$ and $U_3O_{8 \pm x}$. The results obtained agree with the two-step scheme of the oxidation of uranium dioxide. (auth)

42813 COPRECIPITATION OF TRIVALENT AMERICIUM WITH CALCIUM CARBONATE. Bykhovskii, D. N.; Petrova, I. K. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 903-6(1971).

Translated from Radiokhimiya; 13: No. 6, 880-2(1971).

It was established that the degree of coprecipitation of microquantities of trivalent americium with calcium carbonate is determined both by adsorption on the surface and by trapping in the volume of the crystals. The distribution coefficient characterizing adsorption ($D_{surf} \simeq 20$) significantly exceeds the value of the coefficient characterizing the trapping of americium by growing crystals of calcium carbonate, from a solution of the same composition ($\lambda \simeq 2$). (auth)

42814 BEHAVIOR OF ^{137}Cs AND ^{144}Ce IN THE SORPTION SYSTEM SEA WATER–SEDIMENT. Shchebetkovskii, V. N.; Kuznetsov, Yu. V. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 911-13(1971).

Translated from Radiokhimiya; 13: No. 6, 886-8(1971).

The behavior of ^{137}Cs and ^{144}Ce in the sorption system seawater–sediment was investigated in the presence of variation of the specific content of the sorbent. The sorption of ^{137}Cs obeys Henry's Law, which is evidence of homogeneity of the sorbate. The sorption behavior of ^{144}Ce reflects the presence of this microcomponent in the form of several forms with different affinities for the sorbent; at least one type of particle is not absorbed by sea sediments. (auth)

42815 COMPLEX FORMATION OF PROTACTINIUM WITH OXALIC ACID. Rozenkevich, N. A.; D'yachkova, R. A.; Spitsyn, Vikt. I. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 925-7(1971).

Translated from Radiokhimiya; 13: No. 6, 897-9(1971).

The formation of complexes of protactinium with oxalic acid was studied by measuring the distribution of the element in this system $HClO_4-NaClO_4-H_2C_2O_4$–cation exchange resin KU-2 at a constant ionic strength equal to one. The constants of formation of the complexes $PaO(C_2O_4)^+$ and $PaO(C_2O_4)_2^-$ were calculated by the Schubert method. (J.G.B.)

42816 STABILITY OF PROPIONATE COMPLEXES OF Th(IV). Sergeev, G. M. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 928(1971).

Translated from Radiokhimiya; 13: No. 6, 900(1971).

The strength of complex ions of thorium with propionic acid was calculated according to the data of pH-potentiometric measurements. The stability constants of propionate complexes of thorium remained constant in the region of pH ≤ 3 and propionic acid concentrations greater than 4×10^{-2}M. The values of the logarithms of the stepwise stability constants of complex thorium ions with composition 1:1 and 1:2, calculated at various ratios of the components, are tabulated. (J.G.B.)

42817 COMPLEX FORMATION OF THORIUM WITH CERTAIN AMINO ACIDS. Korshunov, I. A.; Sergeev, G. M. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 929-30(1971).

Translated from Radiokhimiya; 13: No. 6, 901-2(1971).

The complex formation of Th(IV) with glycine, α-alanine, phenyl-α-alanine, valine, β-alanine, phenyl-β-alanine, leucine, and proline was studied by pH-potentiometry. Values of the logarithms of the stability constants for complexes of equimolar composition are given. (J.G.B.)

42818 COMPLEX FORMATION OF AMERICIUM, CURIUM, AND PROMETHIUM WITH 1,2-DIAMINOCYCLOHEXANETETRAACETIC ACID. Elesin, A. A.; Zaitsev, A. A. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 931-3(1971).

Translated from Radiokhimiya; 13: No. 6, 902-4(1971).

The complex formation of trivalent ions of americium and promethium in a system with 1,2-diaminocyclohexanetetraacetic acid was investigated by the method of ion exchange on the cation-exchange resin KU-2 under dynamic conditions at the temperature 80°C. The stability constants of complexes with the composition $[MA]^-$, where $M = Am^{3+}$, Cm^{3+}, and Pm^{3+}, and A is the quadruply charged anion of 1,2-DACTA, were determined, and it was shown that the stability constants of complexes of americium and curium differ by 1.5 times. (auth)

42819 SORPTION OF THE POLYVALENT ELEMENTS ON SILICA GEL. I. SORPTION OF PROTACTINIUM ON SILICA GEL FROM SOLUTIONS OF HCl AND H_2SO_4. Caletka, R. (Nuclear Research Inst., Rez, Czech.). Collect. Czech. Chem. Commun.; 37: No. 4, 1267-76(Apr 1972).

The sorption of protactinium on silica gel from hydrochloric and sulfuric acid solutions was investigated in order to establish the effect of the silica gel structure and of the composition of the aqueous phase on the sorption of protactinium and the kinetics of sorption and desorption of protactinium. The uptake of protactinium from hydrochloric acid solutions can be attributed to the sorption of neutral complexes of the type $Pa(OH)_nCl_{5-n}$ (1 to 10M-HCl) and $H_{x-5}PaCl_x$ (>10M-HCl, x = 6 to 8). In dilute sulfuric acid solutions the adsorption of sulfato hydroxo complexes is to be expected while in the concentration range from 3 to 7M-H_2SO_4 the adsorption of neutral bisulfato complexes of protactinium is assumed. (auth)

42820 SPECTROSCOPIC PROPERTIES OF OXALATOFLUORIDE COMPOUNDS OF URANIUM. Belomestnykh, V. I.; Burkov,

V. I.; Kuzel, V. A.; (and others). Zh. Prikl. Spektrosk.; 15: No. 5, 868-76(Nov 1971). (In Russian).

The mono- and trifluorooxalate compounds of uranium were prepared having the following type formulas: $M_3[UO_2F(C_2O_4)_2] \cdot nH_2O$, where M = Cs, Rb, K, Na, NH_4, CN_3H_6; and n = 1, 2, 3; or $M_3[UO_2F_3(C_2O_4)] \cdot nH_2O$, where M = Cs, Rb, K, Na, CN_3H_6; and n = 1, 2, 6. Infrared absorption spectra of these 11 compounds were determined in the region 400 to 2,100 cm^{-1}. (K.S.W.)

42821 CHARACTERISTIC NATURE OF FREQUENCIES OF VALENCE VIBRATIONS OF URANYL. Vdovenko, V. M.; Ladygin, I. N.; Suglobov, D. N. Zh. Prikl. Spektrosk.; 15: No. 6, 1105-9(Dec 1971). (In Russian).

A mathematical analysis was made of the vibrations of mononuclear uranyl complexes on the basis of a model of a specified symmetry. A matrix equation for the complex UO_2L_n was the starting point, in which L was a monodentate monatomic ligand (or bidentate polyatomic ligand with n = 2). The equations indicated that strong constant interactions in halogenide complexes with tetra-coordination UO_2^{2+} vary insignificantly. Shifts in the valence frequencies of uranyl, exceeding the value by the order of 5 cm^{-1}, were associated with a variation in the strong, constant U–O bond. (K.S.W.)

42822 INVESTIGATION OF THE PHASE TRANSFORMATIONS IN RADIOACTIVE SODIUM SULFATE AND TUNGSTATE. Spitsyn, Vikt. I.; Mikhailenko, I. E.; Voronin, Yu. V. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 890-4(1971).

Translated from Radiokhimiya; 13: No. 6, 866-71(1971).

The action of radiation and self-irradiation of sodium sulfate and tungstate on their phase transitions were studied. The effects of slow neutrons, γ rays, and β particles on Na_2SO_4 and Na_2WO_4 were studied. ^{24}Na, ^{181}W, ^{185}W, and ^{187}W were formed in Na_2WO_4, and ^{24}Na and ^{35}S were formed in Na_2SO_4. The influence of the decay of these isotopes on the phase transition was studied. (M.C.G.)

42823 BENZOYLACETONATES OF TETRAVALENT URANIUM AND THORIUM. Grinberg, A. A.; Petrzhak, G. I.; Lozhkina, G. S. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 934-6(1971).

Translated from Radiokhimiya; 13: No. 6, 904-6(1971).

Benzoylacetonates of uranium and thorium were isolated and an attempt was made to detect the theoretically possible isomeric forms, followed by their identification by the method of ir spectroscopy. No reliable indications of the existence of the expected isomerism were observed. (M.C.G.)

42824 CRYSTAL STRUCTURES OF DOUBLE OXIDES OF URANIUM. Kovba, L. M. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 940-1(1971).

Translated from Radiokhimiya; 13: No. 6, 909-10(1971).

The powder method was used to investigate UV_2O_6, while in the case of UVO_5 and β-UMo_2O_8, the data obtained by the powder method were combined with single-crystal data. Coordinates of the atoms are given. (M.C.G.)

42825 THERMODYNAMICS OF THE STRUCTURAL CHANGES IN WATER IN ELECTRODE PROCESSES IN WHICH RARE-EARTH AND ACTINIDE ELEMENTS PARTICIPATE. Krestov, G. A.; Egorova, I. V. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 945-6(1971).

Translated from Radiokhimiya; 13: No. 6, 912-14(1971).

To determine the influence of structural changes in water or the course of electrode processes in which rare earth and actinide elements participate, the entropy components of the electrode potential were divided into structural and nonstructural components. The quantity can take both positive and negative values, with the nonstructural component negative in all cases. (M.C.G.)

42826 CHEMICAL STATE OF ^{222}Rn IN THE α DECAY OF ^{226}Ra IN CERTAIN SOLUTIONS AND CRYSTALS. Gusev, Yu. K.; Kirin, I. S. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 950-2(1971).

Translated from Radiokhimiya; 13: No. 6, 916-18(1971).

The possibility of using chemical changes in processes of α decay of radium-226 for the synthesis of oxygen-containing compounds of radon-222 was discussed. It was shown that as a result of the processes that occur, all the radon accumulated in the α decay of radium-226 in solutions of nitric and perchloric acids and perxenate crystals, after they dissolve in the same acids, are in the elementary state. (auth)

42827 DEFINITION OF THE SOLUBILITY PRODUCT OF $UO_2(OH)_2$ AT ELEVATED TEMPERATURES. Nikolaeva, N. M.; Pirozhkov, A. V. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 9, Ser. Khim. Nauk; No. 4, 73-81(Jul 1971). (In Russian).

The solubility of $UO_3 \cdot H_2O$ in $HClO_4$, HNO_3, and H_2SO_4 was studied by a pH-metric method at 22 to 150°C. The solubility product $UO_2(OH)_2$ ($L_{UO_2(OH)_2}$) was determined and an equation for temperature dependence of a solubility product was evaluated: $\lg L = -26{,}050 + 5{,}349{,}538/T - 1{,}253{,}404/T^2$. (auth)

42828 NEW SOLVENT EXTRACTION PROCESS FOR PREPARATION OF PuO_2 SOLS. Lloyd, M. H.; Tallent, O. K. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 230-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42829 DISSOLUTION OF PLUTONIUM DIOXIDE. Deaton, R. L.; Silver, G. L. (Mound Lab., Miamisburg, Ohio). Contract AT-33-1-Gen-53. Radiochem. Radioanal. Lett.; 10: No. 5, 277-83(30 Jun 1972).

A method for dissolving plutonium dioxide, which consists of reducing the oxide to lower plutonium oxide forms at 1900°C in vacuum, is described. The lower plutonium oxides, which may also be prepared with carbon as an additional reducing agent, dissolve more readily in a nitric acid–hydrofluoric acid mixture than the original plutonium dioxide. (auth)

42830 METHOD FOR DETERMINING DISPROPORTIONATION STOICHIOMETRY. Silver, G. L. (Mound Lab., Miamisburg, Ohio). Contract AT-33-1-Gen-53. Radiochem. Radioanal. Lett.; 10: No. 5, 285-9(30 Jun 1972).

A method of estimating disproportionation stoichiometries of U(V) and Np(V) without recourse to computing machines is presented. Equilibrium fractions of uranium and neptunium ions may also be estimated with this method. (auth)

42831 CHARGING OF RADIOACTIVE PREPARATIONS. Gromov, V. V.; Spitsyn, Vict. I. (Inst. of Physical Chemistry, Moscow). J. Res. Inst. Catal., Hokkaido Univ.; 19: No. 1, 1-16(Apr 1971).

Charge accumulation in radioactive dielectrics was investigated. A theoretical analysis was made from the viewpoint of the dielectric properties of crystals and an environment. The calculation of a charge in radioactive metals, semiconductors, and dielectrics showed satisfactory correlation with experimental determinations. Changes of physico-chemical properties as a result of the charge accumulation was illustrated in case of adsorption and dissolution kinetics of charged crystals in water. (auth)

42832 ATTI DEL CONVEGNO MENDELEEVIANO. Periodicita e Simmetrie Nella Struttura Elementare Della Materia, Torino–Roma, 15–21 Settembre 1969. (Transactions of the Mendeleev Conference. Periodicity and Symmetry in Elementary Structure of Matter, Turin–Rome, 15–21 September 1969). Verde, M. (ed.). Turin; Vincenzo Bona (1971). 465p. (In several languages). (CONF-690945).

Twenty-three papers presented are included. Separate abstracts were prepared for 22 papers. One paper was previously abstracted for NSA. (M.C.G.)

For abstracts of individual papers see: 42747, 42833–42836, 43706, 43833, 43896, 43924, 43981, 44015, 44026, 44027, 44062, 44081, 44082, 44137, 44320, and 44335–44338.

42833 CENTENNIAL OF THE PERIODIC LAW OF MENDELEEV. Spitsyn, V. I. pp 17–48 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971). (In French).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The periodic law of Mendeleev was first published in 1869. Predictions on the existence and properties of unknown elements were made by him on the basis of this law. The special case of the lanthanides and the structure of the electron shells giving them their similar chemical behavior are discussed. The synthesis of the transuranic elements and their place in the periodic table and analogy to the lanthanides are considered. The contribution of the periodic system to the study of the chemical properties of the elements of group 0 is discussed. (J.S.R.)

42834 HEPTAVALENT STATES OF NEPTUNIUM AND PLUTONIUM AND PROBLEM OF THE VALENCE OF ACTINIDES. Spitsyn, V. I. pp 97–123 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971). (In French).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

Studies on the heptavalent states of Np and Pu are reviewed. These include the reduction of the products from the interaction of hexavalent Np and Pu, the preparation of solid state compounds of hexavalent Np and Pu, the oxidation of solutions of the hexavalent ions by different oxidants, and the reduction of the hexavalent ions. The significance of these experimental results in relation to the constitution of the electron shells is considered. (J.S.R.)

42835 TENTH TEST EXPERIENCED BY THE PERIODIC SYSTEM: SEVENTH PERIOD. Haissinsky, M. (Laboratoire Curie, Paris). pp 125-35 of Atti del Convegno Mendeleeviano. /Verde, M. (ed.). Turin; Vincenzo Bona (1971). (In French).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The principal anomalies that cast doubt on the validity of the Mendeleev periodic system are summarized. The problems caused by the seventh period and the discovery of the transuranium elements are discussed in more detail. It was concluded that the elements Th, Pa, and U should remain in columns IV, V, and VI. The new family of rare earths begins with uranium. This series of uranides is characterized by a multiplicity of oxidation states and then, beginning with Cm, by the stabilization and predominance of 3+ valence. This series can be subdivided into two subgroups: the uranides, including elements from Z = 92 to 95, and the curides with Z = 97 to 103. The curides are essentially trivalent and homologous with the isoelectronic lanthanides. Am can be considered as a transition between the two subgroups. (J.S.R.)

42836 PERIODIC SYSTEM OF D. I. MENDELEEV AND PROBLEMS OF NUCLEAR CHEMISTRY. Goldanskii, V. I. (Inst. of Chemical Physics, Moscow). pp 137-62 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The direct connections between the periodic system of elements and some questions in nuclear physics are discussed. Topics covered include: structure of the 8th period of the Mendeleev system and chemistry of new atoms. (M.C.G.)

42837 KINETIC STUDY OF THE OXIDATION OF FORMIC ACID BY NEPTUNIUM(VII) IN AQUEOUS PERCHLORIC ACID SOLUTION. Thompson, Mary; Sullivan, James C. (Coll. of St. Catherine, St. Paul. Argonne National Lab., Ill.). Inorg. Chem.; 11: No. 7, 1707-9(Jul 1972).

The empirical form of the rate law for the reaction $2Np(VII) + HCOOH = 2Np(VI) + 2H^+ + CO_2$ at constant hydrogen ion concentration is $-d[Np(VII)]/dt = k'[Np(VII)][HCOOH]$. At 25°C and $I = 1.0$, $k' = a + b/[H^+]$ where $a = 0.4015\ M^{-1}\ sec^{-1}$ and $b = 5.38 \times 10^{-2}\ sec^{-1}$. Apparent energies of activation for the respective parameters are 6.44 and 10.5 kcal/mol. There is no solvent deuterium effect on the a parameter but one of 4.2 for b. The respective values of a and b for the reaction with DCOOH [25°C, $I = 1.0$] are $2.64 \times 10^{-2}\ M^{-1}\ sec^{-1}$ and $5.10 \times 10^{-3}\ sec^{-1}$ with apparent energies of activation 8.92 and 12.8 kcal/mol. The primary kinetic isotope effects form the basis for the suggestion that the mechanism is similar for the two reaction paths. (auth)

42838 POSSIBILITY OF HETEROVALENT SUBSTITUTION OF $Me^+ + Me^{3+} = 2Me^{2+}$ IONS IN THE STRUCTURE OF CALCIUM URANATE. Evdokimov, A. A.; Trunov, V. K. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 942-4(1971).

Translated from Radiokhimiya; 13: No. 6, 910-12(1971).

The possibility of heterovalent substitution of the Ca^{2+} ion in the structure of calcium uranate was studied. Na and Sm, Na and La, Na and Lu, Na and Sc, and Li and Sm were substituted and cell parameters determined. (M.C.G.)

42839 INTERACTION OF MO_2^{2+} (M = U AND Pu) IONS WITH 5-SULPHOSALICYLIC ACID IN AQUEOUS SOLUTION. Bismondo, A.; Portanova, R.; Di Bernardo, P.; Magon, L. (CNR, Padua). Energ. Nucl. (Milan); 19: No. 6, 402-6(Jun 1972).

The formation of complexes of uranyl(VI) and plutonyl(VI) with 5-sulfosalicylate was investigated by potentiometric $[H^+]$ measurements, and values of the relative stability constants were determined in 1M (H, Na)ClO_4 solution at 20°C. The trend in stability constants for these chelate complexes is compared with that of complexes of the same oxycations with simple monocarboxylate ligands. (auth)

42840 PRECIPITATION AND HYDROLYSIS OF URANIUM(VI) IN AQUEOUS SYSTEMS. VIII. A STUDY OF THE PRECIPITATES FORMED IN THE SYSTEMS URANYL NITRATE–SODIUM CARBONATE–ALKALINE EARTH CHLORIDES. Fueredi-Milhofer, H.; Despotovic, Z.; Devide, Z.; Wrischer, M. (Ruder Boskovic Inst., Zagreb). J. Inorg. Nucl. Chem.; 34: No. 6, 1961-9(Jun 1972).

Uranium-bearing precipitates that formed in the precipitation systems uranyl nitrate (2×10^{-3} N)–sodium carbonate–barium, strontium, calcium, and/or magnesium chloride when alkaline earth chloride was in excess of sodium carbonate were investigated by means of light and electron microscopy, chemical and thermogravimetric analyses, i.r., and x-ray spectroscopy. The precipitate composition was found to be dependent on the initial molar ratio of sodium carbonate and uranyl nitrate. At $[Na_2CO_3]/[UO_2(NO_3)_2] = 1.5$ (final pH 6 to 7) slightly soluble polynuclear complexes containing uranyl, carbonato, and hydroxyl groups, as well as the respective Me(II) ions, were obtained. Me(II) : U : CO_2 molar ratios were 1 : 5 : 1.5 for Me(II) = Sr, Ca and Mg, and 2 : 5 : 1 : 1.5 for Me(II) = Ba. Crystals of $Ba_2UO_2(CO_3)_3 \cdot 6H_2O$ were isolated from the system with barium at initial molar concentration ratios of sodium carbonate and uranyl nitrate between 3 and 30 (final pH ~7). At relatively high initial molar ratios of sodium carbonate and uranyl nitrate (increasing in the order Sr, (Ba), Ca, Mg; final pH ~7) uranium was coprecipitated with the respective alkaline earth carbonate as a carrier. Under the given conditions strontium carbonate coprecipitated up to 6 M%, but calcium carbonate only about 0.6 M% of uranium. The coprecipitation mechanism is discussed. (auth)

42841 INFRARED SPECTROSCOPIC STUDY OF THE MECHANISM OF THE SORPTION OF METAL IONS ON COMPLEX-FORMING RESINS. V. INFRARED SPECTRA OF PHOSPHATE RESINS CONTAINING URANIUM, COPPER, AND NICKEL. Chuveleva, E. A.; Yufryakova, N. K.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 51-4(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 93-8(Jan 1972).

Examination of the infrared spectra of KRF resin in the hydrogen and sodium forms, containing uranium, copper, and nickel, established the presence in the uranium complex of additional coordination with phosphoryl oxygen, to form a four-membered chelate ensuring high affinity between uranium and phosphate groups in the resin. This type of bond is generally absent in copper and nickel compounds, so that the complexes formed are less stable. The results are consistent with the stability constants which were found for the complexes of these ions with phosphoryl groups of the resin. (auth)

42842 FAR-INFRARED SPECTRUM OF URANYL FLUORIDE. Ohwada, K. (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 34: No. 7, 2357-8(Jul 1972).

The infrared absorption spectrum of uranyl fluoride (UO_2F_2) and its normal coordinate analysis was reported previously (Ohwada, 1971). However, two infrared-active bands ($A_{2u} : \nu_4$, $E_u : \nu_8$) calculated previously were not confirmed for lack of data in the far-infrared region below 250 cm^{-1}. It is shown by measurement of the far-infrared spectrum, that three absorption bands are located at 260, 234, and 146 cm^{-1}. The highest strong band centered at 260 cm^{-1} is somewhat lower than that (286 cm^{-1}) observed by Bagnall et al (1968). This band has already been assigned to the U–O–U (uranyl, $E_u : \nu_8$) and F–U–F bending ($A_{2u} : \nu_4$) vibrations, respectively. It was found that these two bands as well as other observed bands were in fair agreement with the calculated frequencies. Therefore, the observation of these two bands gives further confirmation of the results by the normal coordinate analysis described previously. (UK)

Radioactive Waste Treatment

Refer also to abstract 42967.

42843 PLUTONIUM-URANIUM PARTITIONING BY A REFLUX EXTRACTION FLOW SHEET. Bruns, Lester E. (Atlantic Richfield Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 88-90(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42844 LOW-LEVEL LIQUID WASTE TREATMENT AT THE NFS REPROCESSING PLANT. Clark, James R.; McDonald, Gary W. (Nuclear Fuel Services, Inc., West Valley, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 321-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Radioisotope Production

Refer also to abstracts 43212, 43213, and 43684.

42845 IMPACT OF BLIP ON RADIOPHARMACEUTICALS. Lebowitz, E.; Richards, P. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 133-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42846 NEW METHOD FOR ISOLATION OF CARRIER FREE ^{35}S AND ^{32}P FROM NEUTRON ACTIVATED POTASSIUM CHLORIDE. Aly, Hisham F.; Abdel-Hamid, Moustafa M. (Atomic Energy Establishment, Cairo). Microchem. J.; 17: No. 2, 215-19(Apr 1972).

The distribution of phosphate and sulfate anions on a developed extraction chromatographic column was investigated. A working procedure for the separation of carrier-free ^{32}P and ^{35}S from a neutron-activated potassium chloride target was adapted. The procedure proved to be adequate and efficient for production of high purity sulfur-35 and phosphorus-32. The distribution behavior of the species studied was discussed in the light of the different interactions affecting the preferential generation of the anionic species. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 43497.

42847 (DOCKET-50201-124) WEST VALLEY REPROCESSING PLANT. Letters of May 23, June 26, 27, 30, and July 5, 1972, With Respect to Modifications in the Plant. (Nuclear Fuel Services, Inc., Rockville, Md.). 10 Jul 1972. 11p. Dep. NTIS.

The effective date of Technical Specification Change No. 15 to Provisional Operating Licensing No. CSF-1 was postponed until January 1, 1973 and interim requirements for liquid effluents were established. Information is submitted in support of the request for authorization to operate a new off-gas treatment and acid recovery facility. A proposed modification of the fuel receiving and storage area cooler is reviewed. (M.C.G.)

42848 (JUL-826-CT) OFF-GAS TREATMENT IN THE REPROCESSING BY CHLORINATION OF GRAPHITE-CONTAINING NUCLEAR FUEL AND BREEDING ELEMENTS FROM HIGH-TEMPERATURE REACTORS. Barnert-Wiemer, Heidrun (Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie). Jan 1972. 91p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

With the high-temperature chlorination of silicon carbide-containing thorium high-temperature fuel elements, a gaseous mixture of chlorine, silicon tetrachloride, carbon monoxide, phosgene, and fission noble gases results, from which the chlorine must be separated and recycled for economic reasons. In order to achieve this, a physical and chemical purification process was developed. A decision on which process is to apply will mainly depend on the special requirements. Important criteria are the necessary purity of chlorine, the amount of radioactive waste, and the necessity to separate fission noble gases. (auth)

42849 USE OF SOLUBLE NEUTRON POISONS IN NUCLEAR FUEL REPROCESSING. Rohde, K. L.; Lewis, L. C. (Allied Chemical Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 86(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42850 DISSOLUTION OF IRRADIATED MIXED-OXIDE FAST REACTOR FUEL. Lerch, R. E.; Cooley, C. R. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 86-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42851 FUEL REPROCESSING TESTS WITH SHORT-COOLED LMFBR-TYPE FUEL RODS. Goode, J. H.; Vaughen, V. C. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 87-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42852 MACRORETICULAR ANION EXCHANGE RESIN CLEANUP OF TBP SOLVENTS. Schultz, Wallace W. (Alantic Richfield Hanford Co., Richfield, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 90(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42853 REGULATING RADIOACTIVE OFF-GAS EFFLUENTS FROM NUCLEAR FUEL REPROCESSING PLANTS. Workinger, T. R. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 94(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42854 OFF-GAS TREATMENT AT THE ALLIED-GULF NUCLEAR SERVICES BARNWELL NUCLEAR FUEL PLANT. Gray, J. H.; Stelling, H. E.; Ayers, A. L. Allied-Gulf Nuclear Services, Barnwell, S. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 94-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42855 REMOVAL OF KRYPTON FROM THE HTGR FUEL REPROCESSING BURNER OFF-GASES. Glass, R. W.; Meservey, A. B.; Haas, P. A.; (and others) (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 95(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42856 RECENT DEVELOPMENTS IN CONTROLLING THE RELEASE OF NOBLE GASES BY ABSORPTION IN FLUOROCARBONS. Merriman, J. R.; Stephenson, M. J.; Dunthorn, D. I. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 95-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42857 APPLICATION OF METAL ZEOLITES TO NUCLEAR FUEL REPROCESSING PLANT OFF-GAS TREATMENT. Pence, D. T.; Duce, F. A.; Maeck, W. J. (Allied Chemical Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 96(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42858 DESIGN CONCEPTS FOR ZERO-RELEASE FUEL REPROCESSING PLANT. Yarbro, O. O.; Harrington, F. E. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 96-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42859 OPERATIONAL PERFORMANCE AND SAFETY OF A CRYOGENIC SYSTEM FOR KRYPTON RECOVERY. Bendixsen, C. L.; Rohde, K. L. (Allied Chemical Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 97-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42860 RECENT DEVELOPMENTS IN CONTROLLING THE RELEASE OF NOBLE GASES BY ADSORPTION ON ACTIVATED CARBON. Kovach, J. Louis (Nuclear Containment Systems, Inc., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 15: No. 1, 98-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

ENGINEERING

Energy Conversion

Refer also to abstracts 42897, 42916, 42933, 42934, 42985, 43417, and 43542.

42861 (LA–4914) SOURCE TERM CALCULATIONS FOR PIONEER RADIOISOTOPIC THERMOELECTRIC GENERATORS. Bronisz, S. E. (Los Alamos Scientific Lab., N. Mex.). May 1972. Contract W-7405-eng-36. 15p. Dep. NTIS.

Quantities of radioactive material that would be expected to be released as the result of the exposure of a Pioneer radioisotopic thermoelectric generator to certain accident environments have been calculated. The conventions used in these calculations are described in detail, as are the reasons for choosing the conventions. The final source terms are believed to be safety conservative, but the actual degree of conservatism cannot be determined. (auth)

42862 (N–72–18677) NUCLEAR BRAYTON TURBOALTERNATOR–COMPRESSOR (TAC) CONCEPTUAL DESIGN STUDY. Mock, E. A.; Davis, J. E. (Garrett Corp., Phoenix, Ariz. AiResearch Mfg. Div.). Jan 1972. Contract NAS3-13448. 321p. (NASA-CR–111565; APS–5355-R). NTIS.

A comprehensive analysis and conceptual design study of the turboalternator-compressor components was performed using He–Xe as the working fluid. Individual turbine, alternator, compressor, and bearing and seal designs were evaluated. Six turboalternator-compressor (TAC) configurations were completed. One TAC configuration was evaluated to calculate its performance when operating under new cycle conditions, namely, one higher and one lower turbine inlet temperature and one case with krypton as the working fluid. Based on the results, a TAC configuration that incorporated a radial compressor, a radial turbine, a Lundell Alternator, and gas bearings was selected. A new layout of the TAC was prepared that reflects the cycle state points necessary to accommodate a zirconium hydride moderated reactor and a 400 Hz alternator. The final TAC design rotates at 24,000 rpm and produces 160 kWe, 480V, 3-phase, 400 Hz power. (auth) (STAR)

42863 (N–72–19778) ELECTROTHERMAL OSCILLATIONS AND THE QUASILINEAR THEORY OF ELECTRON ENTHALPY FLUCTUATIONS IN MAGNETOHYDRODYNAMIC GENERATORS AND MAGNETOPLASMADYNAMIC ARC THRUSTERS. Smith, J. Marlin (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar 1972. 40p. (NASA-TN-D–6704; E–6660). NTIS.

Fluctuations in electron density and temperature coupled through Ohm's Law were studied for MHD power generator and MPD arc thruster applications. The dispersion relation based on linear theory is derived, and the two limiting cases of infinite ionization rate and frozen flow are examined. The nonlinear effects of the frozen flow case are then studied in the quasilinear limit. Equations are derived for the amplitude of the fluctuation and its effect upon Ohm's Law and the electron temperature equation. Conditions under which a steady state can exist in the presence of the fluctuation are examined, and effective transport properties are determined. (auth) (STAR)

42864 (UCRL–51217) NEW CONCEPT FOR IN SITU COAL GASIFICATION. Higgins, G. H. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Apr 1972. Contract W-7405-eng-48. 17p. Dep. NTIS.

A method is described by which deeply buried coals can be converted to methane through chemical reactions with oxygen and water. The coal would first be shattered with conventional explosives, then retorted with an oxygen–water mixture at between 700 and 1300°K. The reactants would be pumped into the top of the coal deposit at between 500 and 1000 psi and carbon dioxide and methane would be removed from the bottom. No sulfur gases or fly ash should be produced and the water requirements can be fulfilled from brackish water supplies. Coals available and suitable for this kind of gasification might yield as much as 10,000 trillion ft^3 of pipeline gas. This constitutes about 300 times the present annual consumption, and if the process is successfully developed, it could materially alleviate future gas shortages. Rough estimates of process costs based on a plant capacity of 0.1 trillion ft^3 per year indicate that an investor could expect about 20% internal rate of return on a $35 million capital outlay assuming 38¢ per MCF of gas as a field price. Both the capital requirement and selling price are much less than for surface gasification plants. Previous underground gasification has been accomplished with mined-gallery or drill-hole low-pressure burning. The method proposed here should minimize bypassing of the coal by the inlet gases and thereby maintain a high-quality product. This is accomplished by flowing the reactant gases very slowly downward through the shattered coal, keeping the hot zones above the colder ones. This creates a thermally stable advancing hot zone and avoids the mixing of reactants and products. The proposed process will lead to ultimate surface subsidence of many tens of feet over the whole area of reacted coal. Experience from potash mines suggests that there would be no surface disruption. While the concept appears most promising from a theoretical point of view, it is unproven. To test its feasibility it will be necessary to conduct a number of laboratory studies and calculations and to perform pilot-scale field tests in suitable deep coal deposits. (auth)

42865 SOURCES OF CESIUM VAPOR AND OXYGEN IN A CESIUM–OXYGEN SYSTEM FOR THERMIONIC CONVERTERS. Gverdtsiteli, I. G.; Kalandarishvili, A. G.; Ordzhonikidze, K. G.; Tskhakaya, V. K. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 76-7(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 100-2(Jan 1972).

The various phases of a cesium–oxygen system are also cesium and oxygen sources and can be used in a thermionic energy converter to increase the electrical output power. (auth)

42866 CURRENT OSCILLATIONS IN A COLLISIONLESS CESIUM DIODE. Gverdtsiteli, I. G.; Karakhanov, V. Ya.; Kashirskii, E. A.; Kucherov, R. Ya.; Oganezov, Z. A. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 78-84(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 103-10(Jan 1972).

The processes in the collisionless plasma in a cesium diode were studied and related to the current oscillations in the diode circuit. A virtual cathode is found near the emitter and its velocity toward the collector is measured. A mechanism for the oscillations is proposed on the basis of the experimental results. (auth)

42867 NUCLEAR ENERGY: RISKS AND BENEFITS. Perez Luina, Adolfo (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 74, 491-501(Nov-Dec 1971). (In Spanish).

The major problems confronting humanity, peace and population, are discussed. It is shown that abundant, inexhaustible, and cheap electrical energy which can be obtained only by nuclear origin, is the solution of the struggle between population and food supply. An analysis is made of the most important attacks made against nuclear energy. The errors or false interpretations in the majority of these attacks are clarified. A balance is struck between the risks and benefits of nuclear energy. (tr-auth)

42868 ENGINEERING-ECONOMIC ANALYSIS OF A CLOSED-CYCLE POWER PLANT WITH A NONEQUILIBRIUM-PLASMA MHD GENERATOR. Shumyatskii, B. Ya.; Kovbasyuk, V. I.; Shelkov, E. M.; Stolyar, L. P.; Miroshnichenko, V. N. (Inst of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 6, 1162-7(Nov-Dec 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 6, 1264-70(Nov-Dec 1971).

Combining a high-temperature gas-cooled reactor with a plasma MHD generator seems to be a promising step toward improving the engineering-economic indices of closed-cycle power plants, by reducing the specific capital investment through an increase in the plant power and an increase in the thermodynamic efficiency of the cycle. Since even the promising gas-cooled reactors provide a comparatively low (1500 to 1700°C) damping temperature at the input to the MHD generator, the conductivity required for efficient operation of the generator can be achieved only with nonequilibrium ionization of an alkali metal mixture with an inert gas. The choice of parameters for a closed-cycle power plant with a nonequilibrium MHD generator is discussed. The economic indices of such a plant are estimated on the basis of structural considerations. (auth)

42869 END EFFECT IN AN MHD GENERATOR WITH AN OPTIMUM LOAD DISTRIBUTION. Medin, S. A. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 6, 1168-72(Nov-Dec 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 6, 1271-6(Nov-Dec 1971).

The variational problem for the potential distribution in an MHD-generator with semi-infinite electrodes characterized by a maximum power for a given electrical efficiency is formulated and solved analytically. The magnetic field is constant in the electrode region and falls off exponentially outside this region. Calculated data on the mean free path are compared with experimental results. (auth)

42870 THERMAL EFFICIENCY OF URANIUM HEXAFLUORIDE MAGNETOHYDRODYNAMIC UNITS. Gutman, I. I.; Dmitrievskii, V. A.; Tetel'baum, S. D. (Odessa Inst. of Tech.). High Temp. (USSR) (Engl. Transl.); 9: No. 6, 1233-5(Nov-Dec 1971).
Translated from Teplofiz. Vys. Temp.; 9: No. 6, 1329-31(Nov-Dec 1971).

A review of technology related to the use of gaseous nuclear fuel in gas reactors and in magnetohydrodynamic units is presented. It is noted that although the use of UF_6 in nuclear MHD units requires developments in radiation safety, channel construction materials, electrode materials, and reactor cooling methods, the present technology is the basis for a prospective good future in this field. (J.R.D.)

42871 METODY MATEMATICHESKOGO MODELIROVANIYA I OPTIMIZATSII TEPLOENERGETICHESKIKH USTANOVOK. (Methods of Mathematical Model Simulation and Optimization of Heat-Powered Installations). Levental, G. B. (ed.). Moscow; Izdatel'stvo Nauka (1972). 224p.

Computer programs are presented at techniques in model simulation and optimization of heat-powered plants of various types. Algorithms make possible the optimization of continuously and discretely variable parameters, and methods of accelerating their convergence are suggested. Direct application of the methods to magnetohydrodynamic generators, heat and electric power plants, and the design of facilities for organic and nuclear fuels is discussed. 169 references. (K.S.W.)

42872 PROCEDURE AND DEVICE FOR EXPLOITING SOLAR ENERGY. Morihain, M. A. French Patent 2,079,477. 18 Oct 1971. Filed 3 Feb 1970. (In French).

An apparatus for converting solar energy into electrical energy by the creation and exploitation of a local thermal disequilibrium is described. In this apparatus, a rising air current is created by a fixed large surface furnace and a chimney. The apparatus utilizes a braced tubular pylon with a flattened metallic tent (solar furnace) enclosing a large volume of superheated air. A description of the device is given which enables its cost to be evaluated, the overall cost of the device being the most interesting factor. The efficiency of this type of sun-mill is dependent upon the way in which the different parts are constructed (the braced tubular pylon, the tent supported at its center by the pylon, and the turbogenerator system consisting of the air turbine and the power generator). (France)

42873 DESCRIPTION OF THE RADIOISOTOPE-FUELED TRANSIT THERMOELECTRIC CONVERTER POWER SOURCE. Bradshaw, G. B.; Postula, F. D. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 3(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42874 WORLDWIDE STATUS OF GEOTHERMAL EXPLORATION AND DEVELOPMENT. Koenig, James B. (California Div. of Mines and Geology, Sacramento). Trans. Amer. Nucl. Soc.; 15: No. 1, 13(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42875 GEOTHERMAL RESOURCES RESEARCH. Denton, Jesse C. (National Science Foundation, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 13-14(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42876 GEOTHERMAL RESOURCES OF THE UNITED STATES. Rex, Robert W. (Univ. of California, Riverside). Trans. Amer. Nucl. Soc.; 15: No. 1, 14(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42877 CHARACTERISTICS OF GEOTHERMAL RESOURCES AND PROBLEMS OF UTILIZATION. White, Donald E. (Geological Survey, Menlo Park, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 14-15(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42878 EXPLORATION FOR GEOTHERMAL RESOURCES. Combs, Jim (Univ. of California, Riverside); Muffler, L. J. P. Trans. Amer. Nucl. Soc.; 15: No. 1, 15(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42879 PRODUCING A GEOTHERMAL STEAM FIELD. Budd, Chester F. Jr. (Union Oil Co., Cloverdale, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 16(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42880 DESIGN AND OPERATION OF THE GEYSERS POWER PLANT. Finney, John P. (Pacific Gas and Electric Co., San Francisco). Trans. Amer. Nucl. Soc.; 15: No. 1, 16-17(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42881 ECONOMIC POWER FROM GEOTHERMAL HEAT. Anderson, J. Hilbert. Trans. Amer. Nucl. Soc.; 15: No. 1, 17 (Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42882 WATER FROM GEOTHERMAL ENERGY. Laird, D. K. (Univ. of California, Richmond). Trans. Amer. Nucl. Soc.; 15: No. 1, 17(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42883 STIMULATION OF GEOTHERMAL SYSTEMS. Gerber, Carl R. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 19(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42884 PLOWSHARE GEOTHERMAL USE OF NUCLEAR EXPLOSIVE ARRAYS TO FRACTURE HOT ROCK. Burnham, John; Stewart, D. H. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 19-20(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42885 STIMULATION MODES OF GEOTHERMAL AQUIFERS. Ramey, Henry J. Jr.; Kruger, Paul; Raghavan, R. (Stanford Univ., Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 20-1(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42886 INDUCTION AND GROWTH OF FRACTURES IN HOT ROCK. Aamodt, Lee; Smith, Morton (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 21-2 (Jun 1972).
From eighteenth annual American Nuclear Society conference, Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42887 EXPLOSIVE STIMULATION OF GEOTHERMAL WELLS. Austin, Carl F.; Leonard, G. W. (Naval Weapons Center, China Lake, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 22(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42888 ENVIRONMENTAL ASPECTS OF GEOTHERMAL HEAT STIMULATION. Sandquist, Gary M. (Univ. of Utah, Salt Lake City); Whan, Glenn A. Trans. Amer. Nucl. Soc.; 15: No. 1, 22-3(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42889 CORROSION AND SCALING BY STEAM IN NUCLEAR GEOTHERMAL POWER PLANTS. Krikorian, Oscar H. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 15: No. 1, 24(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42890 DILEMMA OF SUPPLYING ELECTRIC DEMANDS IN THE NEW ENVIRONMENTAL ERA. Lee, Byron Jr. (Commonwealth Edison Co., Chicago). Trans. Amer. Nucl. Soc.; 15: No. 1, 72-3(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42891 HYDROGEN ECONOMY. Bockris, J. O'M. (Flinders Univ., Bedford Park, Australia). Science; 176: No. 4041, 1323(23 Jun 1972).

A concept for energy transfer from reactor to use locations using hydrogen is described. According to this concept, nuclear reactors are positioned over deep water on floating platforms. Electricity from the reactors is used to electrolyze water producing hydrogen for transfer to use sites. Advantages inherent in the concept are described. (J.R.D.)

42892 EFFECT OF A TRANSVERSE MAGNETIC FIELD ON THE OPERATION OF A THERMIONIC CONVERTER UNDER UNDERCOMPENSATED KNUDSEN CONDITIONS. Morozov, Yu. G.; Ender, A. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 11, 1914-19(May 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 11, 2412-19(Nov 1971).

The saturation current in an undercompensated Knudsen thermionic converter is analyzed as a function of the magnetic field. Two limiting cases are considered: zero filling and complete filling of the potential well by the ions. It is shown that there are qualitative and quantitative differences in the two cases. The results serve as a basis for an experimental investigation of undercompensated Knudsen operation. (auth)

42893 FEASIBILITY STUDIES ON AN AUXILIARY PROPULSION SYSTEM USING MPD THRUSTERS. Burkhart, James A.; Seikel, George R. (Lewis Research Center, Cleveland). J. Spacecraft Rockets; 9: No. 7, 487-8(Jul 1972).

A number of systems integration problems must be examined before a low-power MPD thruster system can be built for satellite station keeping and attitude control. Three such problems were studied experimentally and are reported. They are: varying the direction of the thrust vector, reducing system power complexity to one power-supply bus, and powering the thruster from rechargeable batteries. Lightweight tank storage of the xenon propellant is examined analytically. (auth)

42894 FEASIBILITY OF HIGH VOLTAGE SOLAR ARRAYS. Bayless, J. R.; Todd, G. T.; Ward, J. W.; Knauer, W. (Hughes Research Labs., Malibu, Calif.). J. Spacecraft Rockets; 9: No. 7, 522-8(Jul 1972).

A detailed feasibility study of high-voltage solar arrays (HVSA), capable of 15 kW at 2 to 16 kV, was performed. The major areas considered were plasma power losses, dielectric stresses, and questions relating to high-voltage design, fabrication, and testing. It was concluded that the space plasma losses should be small except in the ionosphere where they may reach 20 to 30% of the array output power for array potentials of 2000 V. The dielectric strength of conventional coverglass and substrate materials should be adequate to withstand the anticipated voltage gradients; however, the presence of the space plasma may have an effect. Laboratory and space experiments are recommended for an assessment of the interaction between high-voltage surfaces and a tenuous plasma. Providing that dielectric materials maintain their integrity, HVSA designs need only differ slightly from those of conventional low-voltage arrays for most missions. (auth)

42895 IMPROVEMENTS IN FUEL CELLS AND FUEL CELL BATTERIES OPERATING AT HIGH TEMPERATURE. (to Compagnie General d'Electricite). British Patent 1,261,317. 26 Jan 1972. Priority date 16 May 1969, France.

A solid electrolyte fuel cell capable of operating at high temperature is described. The cell is of the type comprising a plurality of elements each formed by a portion of the electrolyte tube, respectively supporting on their internal and external faces, an internal electrode and an external electrode. The electrodes are formed by conductive coatings of suitable nature and texture, the internal electrode of one element being electrically connected to the external electrode of the following element, so as to ensure a series connection of said elements. (R.C.K.)

Facilities and Equipment

Refer also to abstracts 43215, 43290, 43405, and 43545.

42896 (CISE-R-277) CONSTRUCTION AND TESTING OF EQUIPMENT FOR IRRADIATION OF METALLIC FUEL FOR CIRENE IN THE HALDEN REACTOR. Artioli, P.; Morandi, G.; Scaroni, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1968. 123p. (In Italian). Dep. NTIS (U. S. Sales Only).

Results of studies show that if a minimum flow trip setting at 0.75 m/sec in the coolant channel is used the channel will have a safety factor on power of 100% or more. The two requirements are possibility to suppress boiling up to a large power for gamma thermometer calibration, and highly developed boiling throughout most of the channel length, are opposing requirements which are difficult to fulfill at the same time. The ideal solution would be a calibration valve capable of changing from a small opening to the lower plenum to give high quality fog cooling at the upper part of the channel during normal operation, to a large opening allowing the boiling to be suppressed right up to full power. This would, however, mean a redesign of the inlet turbine so that it would be capable of responding to lower flow. Other research results are the basis for concluding that cladding of the IFA-31 and IFA-32 fuel element, irradiated in the HBWR at 16 MW reactor power and in a flux position 1.4 should stand 500 cycles between zero and full power. (auth)

42897 (N-72-18234) DESIGN, PERFORMANCE, AND EVALUATION OF A DIRECT-CURRENT CONTACTOR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS. Mueller, Lawrence A.; Medwid, David W.; Koutnik, Ernest A.; Powell, A. Hamilton (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar 1972. 23p. (NASA-TN-D-6699; E-6627). NTIS.

A direct-current contactor for use in large space power systems was designed, built, and tested. It was developed to be operational in an environment of 540°C and at a pressure of 0.0001 N/m^2 or lower. The contactor is rated to pass 10 A continuously and to interrupt a 20-A current at 10,000 V. It was tested to determine the corona threshold level and the leakage current at different temperatures. Also, it was tested for its closing and interruption ability. (auth) (STAR)

42898 (RDT-E-15-3-T(4-72)) INSULATION/HEATER MODULE-PIPING. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1972. 48p. RSO.

A standard prescribing requirements for insulation/heater module-piping for nuclear and associated applications is presented. (J.R.D.)

42899 (TID-4100(Suppl.69)) ENGINEERING MATERIALS LIST. Sachs, Francis L.; Corey, Ruby L.; Gardner, Helen Lee (comps.) (Technical Information Center (AEC), Oak Ridge, Tenn.). May 1972. 56p.

Twenty-four packages of engineering drawings and specifications are included on nuclear instrument modules, radiation detectors, vacuum gages, centrifugal contactors, hole location gages, terminators, pulse generators, switches, Hanford specifications, communications networks, beam positioners, criticality detectors, dosimeters, television equipment, burnishing tools, strain gages, visual aids for TV, rotating target assemblies, indicator lights, differential thermal analysis equipment, microscopes, control rods, and static detectors. A list of engineering reports and a subject index are also included. (J.R.D.)

42900 PROPOSED DESIGN OF A SODIUM AEROSOL TRAP. Barton, Paul (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 237(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42901 MESON FACTORY AS A NEUTRON IRRADIATION FACILITY. Dudziak, Donald J.; Green, Walter V.; Regenie, Thomas R.; Zukas, Eugene G. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 240-1(Jun 1972).

From eighteenth annual American Nuclear Society conference, Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Heat Transfer and Fluid Flow

Refer also to abstracts 44672 and 44674–44677.

42902 (CISE-R-261) SEVEN ROD CLUSTERS FOR HEAT TRANSFER AND PRESSURE DROP EXPERIMENTS: DESIGN, CONSTRUCTION, AND INSTRUMENTATION. Topical Report No. 59. Adorni, N.; Azzoni, A.; Germani, G.; Lumachi, A.; Misani, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jan 1969. Contract 008.65.1-NTRI. 33p. Dep. NTIS (U. S. Sales Only).

Clustered-rod test elements are described, for heat transfer experiments carried out in the CIRENE-3 program. The rod bundles are 17.96 mm OD with a gap between the rods of 1.38 mm, a heated length of 1610 mm, a spacer pitch of 407 mm, and power of 1.61 MW (230 kW per each rod). Pressure tubes have been also constructed that are 59.41 mm and 61.64 mm in diameter respectively, for a design pressure of 70 kg/cm^2. The pressure tubes, apart from the diameter, are exactly alike and consist of ten electrically insulated segments. This kind of construction, never adopted before, allowed the use of metallic spacers and led to reduction of short circuit probabilities in case of rod bending. (auth)

42903 (CISE-R-271) MATRA: DIGITAL PROGRAM FOR THE STUDY OF THE HYDRODYNAMIC CONDITIONS IN A BOILING CHANNEL DURING FAST TRANSIENTS. Topical Report No. 66. Calicchio, L.; Muscettola, M. (Centro Informazioni Studi Esperienze, Milan (Italy)). Feb 1969. Contract 008.65.1-NTRI. 105p. Dep. NTIS (U. S. Sales Only).

In connection with safety studies for the CIRENE-type reactor, the digital program MATRA has been written to simulate the voiding, following an accident, of a constant area channel, either heated or adiabatic in which a steam-water mixture flows (subcooled water may be present in the initial part of the channel). A partially simplified model has been used for the non-stationary hydrodynamics of a two-phase flow, based on mass and energy conservation equations. The deriving system of quasi-linear partial differential equations has been integrated by using the method of the characteristic curves. The comparison with experimental measurements showed a good agreement between the measured and computed coolant mass content during the transient. The program is written in FORTRAN IV for UNIVAC 1108 (with minor modifications it can be run on IBM 7040). (auth)

42904 (COO-2032-13) THEORETICAL AND EXPERIMENTAL STUDY OF FILM CONDENSATION OF LIQUID METAL VAPORS. Final Report. Springer, George S. (Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering). Jun 1972. Contract AT(11-1)-2032. 16p. Dep. NTIS.

42905 (EUR-4811) SLUGFLOW EQUATION. Nobel, L. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1972. 26p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 40.-.

The validity of the slugflow equation given, among others, by Nicklin et al. is evaluated. It appears that other types of equation are also possible probably due to the fact that the coefficient of the total volume flow rate taken by Nicklin et al. as a constant, in fact would be a function of bubble length and total volume flow rate. This conclusion is based on the assumption that the displaced liquid flowrate per unit of bubble cross-section at the rear-end of the bubble, caused by the relative motion of the bubble, is invariant with this cross-section and with the total volume flow rate. If this theory holds good, the consequences are that the bubble diameter decreases with increasing total volume flow, for constant remaining bubble lengths. (auth)

42906 (GV-758) D140E TURBOMACHINERY COOLING STUDY. Dahm, T. J. (General Electric Co., Danville, Calif. (USA). California Advanced Propulsion Systems Operation). 11 Apr 1961. Contract AT(11-1)-171. 11p. Dep. NTIS. Declassified 27 Oct 1971.

42907 (LA-DC-72-260) CORRECTED AND NEW COMPARISONS OF A HYDRODYNAMICAL THEORY OF CHANNEL BOILING AND DATA ON NITROGEN AND HYDROGEN. Sydoriak, Stephen G. (Los Alamos Scientific Lab., N. Mex.). [1972]. 17p. (CONF-720803-4). Dep. NTIS.

From Cryogenic engineering conference; Boulder, CO. (9 Aug 1972).

Channel boiling data of three laboratories are compared with a 1957 hydrodynamic theory based on the assumptions that the fluid flow in an evaporator is frictionless and homogeneous. Areas of excellent agreement (within 5%) are found in forced flow data on nitrogen undergoing nucleate boiling and in hydrogen undergoing both nucleate and film boiling. Where agreement is not as good, the qualitative behavior of both N_2 and H_2 is such as to indicate that the flow is indeed frictionless and homogeneous, and that static bubbles or film attached to the heated wall may be responsible for the observed deviations from theory. The channel boiling equation contains the term Δx, the increase in quality between inlet and exit. This is often unknown, especially in peak nucleate boiling natural convection experiments. However, the efficiency, E, which is the ratio of the observed peak nucleate boiling heat flow to that calculated for an "ideal" evaporator ($\Delta x = 1$), is found to be a simple function of channel gap, S'. It is also found that $E = a(S' - c)/S'(S' + b)$ with a, b, and c equal to 0.18, 0.21 and 0.007 for nitrogen gaps from 0.02 to 0.3 cm and for channel heights of 8 and 15 cm. Less extensive hydrogen data suggest $a = 0.28$, $b = 0.40$ and $c = 0.01$. (auth)

42908 (SC-DR-720393) TWO-DIMENSIONAL THERMAL ATTENUATION OF A LASER PULSE IN A SOLID. Donaldson, A. B. (Sandia Labs., Albuquerque, N. Mex.). Jun 1972. 20p. Dep. NTIS.

The transient, two-dimensional temperature field induced in both a semi-infinite solid and a slab by an instantaneous disk pulse of energy at a surface is developed. The analysis utilizes decomposition of the problem into radial and axial components, which allows treatment of anisotropic materials. The radial temperature component is expressed in terms of the circular coverage function. (auth)

42909 (SC-RR-710657) SIMILARITY ANALYSIS OF THERMAL STRESS. Wessling, F. C. (New Mexico Univ., Albuquerque); Stewart, R. E. D. (Sandia Labs., Albuquerque, N. Mex.). Jun 1972. 72p. Dep. NTIS.

A similarity analysis of the transient temperature and thermal stress distributions occurring in a homogeneous, isotropic solid of arbitrary shape, subjected to an arbitrary heating distribution over its surface, is carried out in order to derive the scaling relations necessary to properly model thermal shock problems. The analysis treats solids with temperature dependent properties, internal heat generation, and radiation from external surfaces. The results of the analysis are subsequently simplified for various special cases of interest. The particular case of a solid right circular cylinder with no internal heat generation, and subjected to a step function heating pulse over one end, is treated in some detail. Computer generated plots of the nondimensional temperatures and stresses occurring in solid zirconium dioxide cylinders as a function of nondimensional time or position are presented with other pertinent nondimensional similarity variables treated as parameters. A limited number of experimental tests are conducted and the experimental results compared with the theory. An error analysis is also carried out to determine the relative importance of the various material properties and also the magnitude of the errors in predicted temperatures and thermal stresses resulting from inaccuracies in material property values, applied heat flux, and test time. (auth)

42910 TRACER MEASUREMENT OF FLOW RATES, FLOW CHANNEL VOLUMES, AND RESIDENCE TIME DISTRIBUTIONS IN LAMINAR FLOW. Felder, R. M.; Gardner, R. P. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 15: No. 1, 172-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42911 NUMERICAL SIMULATION OF THE NAVIER-STOKES EQUATIONS IN FOURIER SPACE. Travis, J. R. (Argonne National Lab., Ill.); Giorgini, A. Trans. Amer. Nucl. Soc.; 15: No. 1, 258-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607

42912 NUMERICAL SIMULATION OF TURBULENT COUETTE FLOW. Leonard, A.; Sicilian, J. M. (Stanford Univ., Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 277-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42913 TRANSIENT VAPOR FILM BEHAVIOR DURING QUENCHING. Stevens, J. W. (Shell Development Co., Houston, Tex.); Witte, L. C. Trans. Amer. Nucl. Soc.; 15: No. 1, 418-20 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42914 CORRELATION FOR THE MINIMUM WALL SUPERHEAT IN FILM BOILING. Henry, Robert E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 420-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42915 ANNUAL REVIEW OF FLUID MECHANICS. VOLUME 4. Van Dyke, Milton; Vincenti, Walter G. (eds.). Palo Alto, Calif.; Annual Reviews Inc. (1972). 512p. $10.00.

Sixteen papers are included in the volume. An abstract was prepared for one paper. Papers for which no abstracts were prepared are concerned with tectonics, disturbances in fluid flow, protozoa locomotion, earth core magnetohydrodynamics, chemically reacting flows, vortex breakdown, intermediate asymptotics, oil spreading on seawater, sailing vessels, and aerodynamics. (J.R.D.)

For abstracts of individual paper see: 42989.

42916 GENERALIZED MHD COUETTE FLOW WITH HEAT TRANSFER BETWEEN TWO POROUS WALLS UNDER TRANSVERSE MAGNETIC FIELD. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Bull. Calcutta Math. Soc.; 59: No. 3-4, 185-95(1967).

An analysis is presented for the velocity distribution, shearing stress, and heat transfer in generalized MHD Couette flow of an electrically conducting, viscous, incompressible fluid, between two porous walls, under transversely applied magnetic field. Expressions for magnetic field velocity, shearing stress, temperature and Nusselt number are derived in closed form and numerical calculations are carried out, both in case of suction and injection by choosing different values for P_1 and the Hartmann number M. Magnetic field profiles, and velocity profiles are shown graphically. (Indian Sci. Abstr.)

42917 VOID FRACTIONS AND HEAT TRANSFER COEFFICIENTS FOR SODIUM–ARGON IN TWO-PHASE FLOW IN A VERTICAL CHANNEL. Ochiai, Masa-aki; Kuroyanagi, Toshiyuki; Kobayashi, Kiyoshi; Furukawa, Kazuo. Heat Transfer - Jap. Res.; 1: No. 2, 65-73(1972).

The void fraction of a vertical upward two-phase flow of sodium-argon was measured using two electromagnetic flowmeters and a γ-ray attenuation measuring equipment. It was shown that the statistical error of the void fraction measured by γ-ray attenuation method was larger than that by the electromagnetic flowmeters method when the gas flow rate was small (probably bubbly flow), but the void fraction measured by the electromagnetic flowmeter method indicated unreasonable values when the gas flow rate was large (probably slug flow). Heat transfer measurements were also made with sodium-argon two-phase flow and uniform heat flux. The results were compared with the heat transfer coefficient for sodium in single-phase flow. The injection of gas caused the heat transfer coefficient in two-phase flow to decrease from its value for sodium in single-phase flow. Further increase in the gas flow rate resulted, after passing a minimum, in a further increase of the heat transfer coefficient. (auth)

Materials Testing

Refer also to abstracts 43015, 43017, 43166, 43167, 43170, 43465, and 43496.

42918 (CEA-R–4208) NEUTRON RADIOGRAPHY WITH REACTORS OF THE C.E.A. Desandre-Navarre, Christian; Farny, Gerard; Perves, Jean-Pierre (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Mar 1972. 69p. (In French). Dep. NTIS (U. S. Sales Only).

Studies on neutron radiography experiments began in France in 1966. Since that time, the tests undertaken at Cadarache, Fontenay, Grenoble, and Saclay enabled one to improve operating techniques and to perfect routine devices. Several inspection facilities were built and are now at the experimenters' disposal in each center of the C.E.A. After a brief summary of the basic principles of this NDT method, a full statement of neutron radiography in nuclear reactors is given, particularly the different qualities of the used sources (cold, thermal, and epithermal neutrons), the collimators (immersed or in beam tube, divergent or Soller type) and the detection systems. Three kinds of detection are discussed: (1) Direct method, in which the image is recorded and visualized instantaneously by means of a sensitive surface coupled to an optical device (hypersensitive camera, image intensifier). (2) Semi-direct method, which uses a converter and an emulsion (e.g., x-ray film) placed together in the neutron beam. (3) Transfer method, in which the converter alone is irradiated in the neutron beam. In each case, the main features and parameters are mentioned and photographs are used to show the quality of the process. (auth)

42919 (ZJE–118) SAFETY OF STRUCTURES AGAINST THE BRITTLE FAILURE. Kalna, K. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 27p. (CONF-701070–1). Dep. NTIS (U. S. Sales Only).

From second symposium on fractures; Marianske Lazne, Czechoslovakia (20 Oct 1970).

Basic criteria used for the evaluation of a structure safety against brittle fracture are transition temperature, fracture toughness, and crack opening displacement. The applicability of criteria and their advantages are discussed. Fracture toughness tests are described in terms of testing procedure and the method of evaluation of test records. Selection of the most acceptable specimen type is discussed for individual tests. In order to define the safety of a structure, its dependence of yield stress and tensile strength on the temperature, the dependence of crack arrest temperature on the nominal stress, and the dependence of the fracture toughness on the temperature must be known. The acceptable length of a crack with respect to safe operating conditions of the structure may be determined by defining these parameters. (auth)

42920 INDUSTRIAL RADIOGRAPHY. Crawford, A. H. Engineering; 211: No. 7, 773-6(Oct 1971).

A short general survey is given indicating the fields of usefulness of x, gamma, and neutron irradiation. 49 ref. (Metals Abstr.)

42921 APPLICATIONS OF NEUTRON RADIOGRAPHY TO VAPOR TRANSPORT FUEL PINS. Lanzo, Chester D. (Lewis Research Center, Cleveland); Winterich, Donald C.; Thaler, Lawrence A. Trans. Amer. Nucl. Soc.; 15: No. 1, 141-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42922 IMAGING OF TARGET CONFIGURATIONS THROUGH METAL SLABS USING ULTRASONIC HOLOGRAPHY. Toffer, Hans (Douglas United Nuclear, Inc., Richland, Wash.); Albrecht, R. W.; Hildebrand, B. P. Trans. Amer. Nucl. Soc.; 15: No. 1, 368-70(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42923 TESTING OF IRRADIATED FULL SIZE CHARPY IMPACT SPECIMENS HEATED IN PLACE. Wotton, B. L.; Hosbons, R. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mater. Res. Stand.; 12: No. 6, 26-7; 56(Jun 1972).

Equipment for testing full size Charpy impact specimens after irradiation is described. Specimens are heated or cooled in the test position with nitrogen gas, and a uniform temperature zone extending $^3/_8$ in. on either side of the specimen notch can be obtained. The setup and heating and cooling procedures are simple and reliable, so impact tests can be performed in a minimum time. (auth)

Nuclear Explosions

Refer also to abstracts 42883–42885, 42888, 42889, 42960, and 42961.

42924 (LA-DC–72-484) HIGH ALTITUDE IRON VAPOR RELEASE. Beardall, J. S.; Peek, H. M.; Jeffries, R. A. (Los Alamos Scientific Lab., N. Mex.). [nd]. 14p. (CONF-720432–1). Dep. NTIS.

From fifteenth midcourse measurements meeting; Arlington, VA. (19 Apr 1972).

One-hundred pounds of ferrocene was shock heated and dispersed in the atmosphere at 65.6 km altitude. At 11.4 microns, 1.9 megawatts peak power and 0.48 megajoule total energy was measured from the source using an airborne radiometer. It is believed the signal was from molecular FeO. (auth)

42925 EFFECT OF GEOLOGIC MEDIUM AND DEPTH ON CAVITY RADIUS. Orphal, D. L. (Environmental Research Corp., Las Vegas, Nev.). Trans. Amer. Nucl. Soc.; 15: No. 1, 24-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42926 CALCULATIONS OF CLOSE-IN GROUND MOTION FROM MULTIPLE DETONATIONS. Power, F. W. (Environmental Research Corp., Las Vegas, Nev.). Trans. Amer. Nucl. Soc.; 15: No. 1, 25-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42927 CRATERING IN AN UNDERWATER ENVIRONMENT. Gillespie, Richard H.; Sprague, Kenneth E. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 15: No. 1, 26-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42928 NUCLEAR EXPLOSION SERVICES FIELDING SYSTEM FOR FUTURE PLOWSHARE PROJECTS. Perry, E. N.; Neuer, J. J. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 27(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42929 NUCLEAR CHIMNEY STORAGE OF NATURAL GAS IN THE VICINITY OF NORTH CAROLINA. Zumwalt, L. R. (North Carolina State Univ., Raleigh); Brown III, E. A. Trans. Amer. Nucl. Soc.; 15: No. 1, 27-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42930 TEMPERATURE IN A CHIMNEY FORMED BY AN UNDERGROUND NUCLEAR EXPERIMENT. Parks, D. E. (Systems, Science, and Software, La Jolla, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 28-9(Jun 1972).

From eighteenth annual American Nuclear Society conference, Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Protective Structures and Equipment

42931 (AE–450) DEPOSITION OF AEROSOL PARTICLES IN ELECTRICALLY CHARGED MEMBRANE FILTERS. Stroem, Lars (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 58p. Dep. NTIS (U. S. Sales Only).

A theory for the influence of electric charge on particle deposition on the surface of charged filters was developed. It has been tested experimentally on ordinary membrane filters and Nuclepore filters of 8 μm pore size, with a bipolar monodisperse test aerosol of 1 μm particle diameter, and at a filter charge up to 20 $\mu C/m^2$. Agreement with theory was obtained for the Coulomb force between filter and particle for both kinds of filters. The image force between charged filter and neutral particles did not result in the predicted deposition in the ordinary membrane filter, probably due to lacking correspondence between the filter model employed for the theory, and the real filter. For the Nuclepore filter a satisfactory agreement with theory was obtained, also at image interaction. (auth)

Safety Engineering

Refer also to abstracts 43206 and 43641–43643.

ENVIRONMENTAL AND EARTH SCIENCES

42932 COMPLIANCE WITH FEDERAL ENVIRONMENTAL ACTS. Steinfeld, Jesse L. (Public Health Service, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 72(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42933 AEC'S RESPONSE TO ENVIRONMENTAL LEGISLATION. Muntzing, L. Manning (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 73(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42934 EPA, ENVIRONMENTAL LEGISLATION AND ENERGY. Lieberman, Joseph A. (Environmental Protection Agency, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 73(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42935 SCIENTIFIC APPLICATIONS OF PARTICLE TRACKS IN SOLIDS. Fleischer, Robert L. (General Electric Research and Development Center, Schenectady, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 115(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Minerals and Ores

Refer also to abstract 43081.

42936 TRACK ETCH TECHNIQUE FOR URANIUM EXPLORATION. Gingrich, J. E.; Lovett, D. B. (General Electric Co., Pleasanton, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 118-9 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42937 URANIUM POTENTIAL OF AUSTRALIA. Liddy, John C. Aust. Mining; 64: No. 5, 24-33(May 1972).

A detailed account of known uranium bearing deposits in each state of Australia is given. In Queensland at Mary Kathleen 7,429,523 lbs U_3O_8 were produced to 1962. In March 1968 reserves estimated to 200 ft. below the valley floor were 2,871,000 tons at 3.26 lb U_3O_8/ton. In South Australia at Radium Hill when mining ceased in 1961 1.878 million pounds of U_3O_8 were extracted from 954,000 tons of ore; at Crocker's Well estimated tonnages of absite per vertical foot from drilling total 12,000 containing 32% UO_3; at Mount Victoria total probable reserves are 67,900 tons at 6.95 lb U_3O_8/ton and 107,900 tons at 6.0% U_3O_8/ton. In the Northern Territory at Rum Jungle a total of 967,000 tons of ore averaging 7.39 lb U_3O_8/ton and 402,000 tons averaging 6.27 lb U_3O_8/ton with 2.7% Cu have been mined. Figures for other orebodies around Rum Jungle are given together with known mineralizations in all other Australian states. (Australia)

42938 CONTENT OF MOBILE URANIUM IN EXTRUSIVE AND INTRUSIVE ROCKS OF THE EASTERN MARGIN OF THE SOUTH MINUSINSK BASIN. Kovalev, V. P.; Malyasova, Z. V. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geochem. Int. (Engl. Transl.); 8: No. 4, 541-9(May 1971).

Translated from Geokhimiya; No. 7, 855-65(Jul 1971).

It has been demonstrated by selective leaching of uranium from intrusive and extrusive rocks covering a broad compositional range, that extrusive rocks are practically devoid of mobile uranium. Glasses obtained by melting intrusive rocks also retain uranium. This may be explained by dispersion of uranium in dissolved form in the glassy ground mass of extrusive rocks and by formation of a film of silica gel on the rock grains subjected to the action of leaching solutions. This film prevents diffusion of uranium and can be destroyed only at rather high temperatures. These facts have a bearing on the mobilization of uranium by hydrothermal solutions from igneous rocks. (auth)

42939 HELIUM ISOTOPES IN NATURE. Kamenskii, I. L.; Yakutseni, V. P.; Mamyrin, B. A.; Anufriev, S. G.; Tolstikhin, I. N. (All-Union Petroleum Geological Surveying Research Inst., Moscow. Inst. of Precambrian Geology and Geochronology, Leningrad). Geochem. Int. (Engl. Transl.); 8: No. 4, 575-89 (May 1971).

Translated from Geokhimiya; No. 8, 914-31(Aug 1971).

Helium isotope compositions are reported for natural gases in sedimentary series, mud volcanoes, and eruptive volcanoes. The $^3He/^4He$ ratio in natural gases varied from 10^{-10} to 10^{-5}. The concentrations of ^3He and ^4He in underground gases are linearly related, which indicates that ^3He has largely a nuclear origin. There was also $^3He/^4He$ stratigraphic differentiation, low values being characteristic of gases in ancient platforms, and higher ones of young deposits in Epihercynian platforms and (especially) regions of pronounced downwarping. Eruptive volcanoes gave values close to those for meteorites, so it was concluded that primordial helium is retained within the earth. (auth)

42940 CONDITIONS OF FORMATION OF CARBONATES IN VEINS OF THE LEAD–COBALT–NICKEL–SILVER–URANIUM TYPE. Naumov, G. B.; Motorina, Z. M.; Naumov, V. B. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geochem. Int. (Engl. Transl.); 8: No. 4, 590-8(May 1971).

Translated from Geokhimiya; No. 8, 938-48(Aug 1971).

There is a single sequence of carbonates that replace one another: calcite, dolomite, ankerite, and siderite. These are deposited at a constant temperature as a result of increase in the CO_2 content of the mineralizing solutions. This has been deduced from the minerals in typical veins of this type and from gas–liquid inclusions. Thermodynamic calculations show that this can occur when CO_2 bearing solutions react with the country rocks and extract cations during metasomatism. Deposition of the iron carbonates requires not only elevated P_{CO_2} but also suitable lowering of the redox potential and low sulfur activity, a circumstance which is also reflected in the production of arsenide parageneses instead of sulfide ones. (auth)

42941 RARE EARTH ELEMENTS, YTTRIUM, AND THORIUM. PART II. World Miner. Metals; No. 7, 11-14(1972).

This is the concluding part of a two-part article on the rare earths, yttrium, and thorium based on the recently published survey by the U. S. Bureau of Mines, called "The Rare Earth Elements, Yttrium and Thorium. A Materials Survey" (IC 8476). In this part the principal processors and uses of the elements and compounds are covered, and points of marketing interest brought out. (auth)

Radioactive Effluents

Refer also to abstracts 42847, 42853—42856, 42858—42860, 42890, 42965, 42985, 43171, 44794, 44840, 44850, 44868, 44877, 44880, 44890, and 44921.

42942 CHARACTERIZATION OF TRITIUM STACK EFFLUENT FROM A FUEL REPROCESSING PLANT. Cochran, Joseph A.; Griffin, William R. Jr.; Troianello, Emilio J. (Environmental Protection Agency, Winchester, Mass.). Trans. Amer. Nucl. Soc.; 15: No. 1, 79(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42943 RESPONDING TO PUBLIC CONCERN OVER MAN-MADE RADIOACTIVITY IN THE ENVIRONMENT. Rohwer, P. S. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 545-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42944 PROTECTION OF THE PUBLIC FROM RADIOACTIVITY PRODUCED IN NUCLEAR POWER REACTORS. Pigford, Thomas H. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 15-26(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The possible and potential risks to individuals due to radioactivity generated in nuclear power plants and the means of protecting the public from those risks are analyzed. Information is included on: the production of radioactivity in a nuclear plant expressed in terms of the amount of radioactivity in Ci/W of thermal power for each of several important fission products; the maximum permissible exposures; normal radioactivity releases; the fate of reactor-produced radioisotopes through fuel reprocessing and ultimate storage; the possibility of accidental releases of radioactivity; and recommendations for developing more reliable methods for nuclear plant risk analysis. (L.C.L.)

42945 ENVIRONMENTAL RADIATION: PAST, PRESENT, AND FUTURE. Gustafson, Philip F. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 104-6(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

At present, as in the past, the bulk of environmental radiation comes from natural sources, cosmic radiation, and natural radioactivity. The normal dose to man from natural sources ranges from about 60 to 250 mrads/year. Fallout from weapons testing has provided as much as 20 to 25 mrads/year during the early to mid-1960's. At present, medical uses provide 20 to 100 mrads/year to the average individual in the U. S. Radiation to the general population from nuclear power is insignificant at present. With the trend toward improved technology in the control and containment of radioactivity from nuclear facilities, future levels should not exceed those observed from fallout. Improvements in radiological procedures should materially reduce unnecessary exposure from this application. (auth)

Radioactivity Transport and Monitoring

Refer also to abstract 43279.

42946 (EUR-4805) ENVIRONMENTAL RADIOACTIVITY: ISPRA, 1970. de Bortoli, M.; Gaglione, P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1972. 46p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 60.-.

The 1970 activities of the site survey group of the Protection Division at the Euratom Joint Research Center—Ispra Establishment are reported. This group works on the radiation protection of the population affected by radioactive effluents from the Establishment. The results of measurements carried out directly on the effluents as well as in the environment are presented in order to assess the contribution by the Establishment to the population dose and the pre-existing radiation and contamination levels of natural origin and those due to worldwide fallout. (auth)

42947 (NRL-F-47) FALLOUT FROM NUCLEAR WEAPONS TESTS CONDUCTED BY FRANCE IN THE SOUTH PACIFIC FROM JUNE TO AUGUST 1971 AND COMPARISONS WITH PREVIOUS TEST SERIES. Gregory, L. P. (comp.) (National Radiation Lab., Christchurch (New Zealand)). Mar 1972. 41p. Dep. NTIS (U. S. Sales Only).

Since mid-1959 long-lived radioactive components in global fallout have been routinely monitored in New Zealand and at some Pacific Islands. In addition, special monitoring programs have been conducted to monitor short-lived fresh fission debris produced during, and for some months after, nuclear weapons tests. The main objective of the monitoring programs is the assessment of public health hazards from nuclear weapons tests carried out in the atmosphere. The levels of radioactivity were determined by measuring the contamination in samples of air filters, rainwater, milk, and cattle thyroid. Data are discussed and tabulated. (P.C.H.)

42948 ENVIRONMENTAL RADIOACTIVITY MEASUREMENT EXPERIENCE NEAR A FUELS REPROCESSING PLANT. Anderson, Kurt D. (New York State Dept. of Environmental Conservation, Albany). Trans. Amer. Nucl. Soc.; 15: No. 1, 544-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42949 ENVIRONMENTAL RADIATION DOSIMETRY NEAR LARGE NUCLEAR POWER STATIONS. Lowder, Wayne M. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 15: No. 1, 545(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42950 ENVIRONMENTAL DECISIONS IN NUCLEAR ENERGY. Whatley, Alfred T. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 168-71(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov .971). See CONF-711111.

The political, social, and technical problems involved in reaching environmental decisions related to nuclear projects are described and discussed. The specific nuclear projects in the western US used to illustrate these problems include the mining of uranium and the subsequent accumulation and use of uranium mill tailings, the use of underground nuclear explosions for stimulating natural gas production, and the siting of nuclear power plants. The complexity of the decision-making process is stressed. (L.C.L.)

Atmosphere

Refer also to abstract 43173.

42951 (NP-19344) RADIOACTIVE FALLOUT MEASUREMENTS AT MOL. Boulenger, R.; de Maere, X. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1968. 103p. (In French and Dutch). Dep. NTIS (U. S. Sales Only).

The results of the measurements of the radioactive dust in the air at ground level, the radioactivity of precipitation, and the radioactivity of milk made at Mol during 1968 are reported in graphs and tables. The total α and β activities, the strontium activity, and the radioactivity of various γ emitters were measured. (J.S.R.)

42952 ACCURACY AND PRECISION OF THE KUSNETZ METHOD FOR THE DETERMINATION OF THE WORKING LEVEL IN URANIUM MINES. Groeer, P. G. (Argonne National Lab., Ill.). Health Phys.; 23: No. 1, 106-9(Jul 1972).

It is stated that the method used almost exclusively to determine the working level (WL) is the Kusnetz method (Am. Ind. Hyg. Assoc. Quart. 17: 85 (1956)). This approximate method consists of filtering a predetermined volume of the air, waiting at least 40 min, then measuring the residual total α-activity and extrapolating this to the WL at the time of sampling. Owing to the fact that disintegrations per minute per liter are converted to WL by a factor that is only a function of the time elapsed since the end of the sampling period the method is only approximate. The state of daughter equilibrium is neglected, and the influence of build-up of activity during the sampling period is not considered. The accuracy of the method was investigated by calculating the total α-activity for a given set of Rn daughter concentrations at a given time after the end of sampling. The precision of the method was also estimated for sampling and counting equipment in use in U mines. (UK)

42953 RADON DAUGHTERS AND AGE OF VENTILATION AIR. Rolle, R. (Chamber of Mines Research Organization, Marshalltown, S. Afr.). Health Phys.; 23: No. 1, 118-20(Jul 1972).

It is stated that in the problem of the ventilation of U mines a knowledge of the distribution of radon daughters throughout the ventilation system is of considerable importance, and a concept referred to as the "radioactive age" of air can be valuable in estimating the relative distributions of these daughters. The "age" of a ventilation stream can be calculated from the time at which significant amounts of radon begin to accumulate in the air. Among matters discussed are types of daughter build-up, mixing of the air, and renewal of daughters. (UK)

42954 LOW-LEVEL ENVIRONMENTAL MONITORING BY FLUCTUATIONS' ANALYSIS. Thie, Joseph A. Trans. Amer. Nucl. Soc.; 15: No. 1, 84(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42955 MEASUREMENT OF ENVIRONMENTAL LEVELS OF RARE-GAS NUCLIDES AND THE TREATMENT OF VERY LOW-LEVEL COUNTING DATA. Currie, Lloyd A. (Univ., Bern. National Bureau of Standards, Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 119-26 (Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The radioisotopes of the rare gases provide unique geophysical and meteorological information concerning the properties and history of our (atmospheric) environment. The extremely low activity levels, however, require very special methods of measurement, experiment design, and data interpretation. Following an examination of the decay characteristics and atmospheric abundances of Kr and Ar radioisotopes, the question of experiment planning and data interpretation in the "extreme Poisson" (few counts) region is considered. A reduced activity plot is offered as an aid for making rapid evaluations and decisions in this region. The concept of an effectively zero background is illustrated by means of atmospheric ^{37}Ar data. Finally, the problem of the blank is examined, and the merits and deficiencies of three alternative approaches are discussed, again with special emphasis on the measurement of ^{37}Ar in Nature. (auth)

42956 TECHNIQUES FOR MONITORING AND ANALYSIS OF ENVIRONMENTAL TRITIUM. Mullins, James W.; Andrews, Vernon E.; Dunn, Leslie M. (Western Environmental Research

Lab., Las Vegas, Nev.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 177-80(Feb 1972).
From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Routine sampling techniques are acceptable for environmental tritium, although attention must be paid to the chemical and physical state of the tritium. Liquid scintillation and gas counting techniques are both acceptable for counting tritium, with gas counting being the most sensitive. Sensitivities for tritium can be increased greatly by electrolytic enrichment before counting. (auth)

42957 GENERAL RADIOACTIVITY OF DUST SUSPENDED IN THE ATMOSPHERIC AIR OF SOME POLISH TOWNS. Just, J.; Maziarka, S. (State Inst. of Hygiene, Warsaw). Gaz, Woda Tech. Sanit.; 45: 174-6(1971). (In Polish).

The sources of atmospheric pollution with radioactive substances, are discussed and the results of measurements of the radioactivity of dusts contained in the atmosphere of Polish towns are presented. (auth) (NSA of Poland)

42958 CONCENTRATION OF ^{14}C IN THE TROPOSPHERE DURING 1953 TO 1971. Vinogradov, A. P.; Devirts, A. L.; Dobkina, E. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 2, 131-6(Feb 1972). (In Russian).

New data up to 1971 on concentrations of radioactive carbon in tropospheric carbon dioxide are given for the period after cessation of nuclear tests in 1961 to 1962. According to experimental data the average time of CO_2 molecule presence in the troposphere before passing into the ocean has been determined to be 9.9 ± 0.3 years. An estimation has been made that, provided the absence of additional sources of artificial ^{14}C introduction into the atmosphere, the cosmic level will be reached at the end of the second decade of the 21st century. (auth)

Soil

Refer also to abstract 42984.

42959 CHARACTERIZING THE TERRESTRIAL RADIATION ENVIRONMENT BY AERIAL SURVEYS. Burson, Z. G.; Boyns, P. K.; Fritzsche, A. E. (EG and G, Las Vegas, Nev.). Trans. Amer. Nucl. Soc.; 15: No. 1, 544(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Water

42960 (NVO-1229-113(Pt.2)) TRITIUM ANOMALIES ON AMCHITKA ISLAND, ALASKA. PART II. Castagnola, D. C. (Teledyne Isotopes, Las Vegas, Nev.). Sep 1969. Contract AT(29-2)-1229. 23p. Dep. NTIS.

Following the Long Shot Event on Amchitka Island, Alaska, sensitive radiological surveillance efforts detected anomalous concentrations of tritium, radioiodine, and radiokrypton in surface water and soil gas samples collected in the vicinity of Long Shot surface ground zero. Anomalous tritium levels ranged from several hundred to several thousand tritium units above natural background levels. Anomalous radiokrypton levels ranged from several hundred to several thousand times natural background levels. The only reasonable source of these anomalies was the Long Shot nuclear explosion. (auth)

42961 (NVO-1229-172) AN INTERIM SUMMARY OF TRITIUM DATA FOR STS "A", AMCHITKA ISLAND, ALASKA JULY 1, 1970 THROUGH JUNE 30, 1971. Essington, E. H. (Teledyne Isotopes, Las Vegas, Nev.). Sep 1971. Contract AT(29-2)-1229. 75p. Dep. NTIS.

Extensive sampling programs were conducted at Amchitka Island, Alaska to ascertain the levels of radioactivity in the land-surface and near-shore ocean waters. Results of tritium analyses for the period of July 1, 1970 through June 30, 1971, are tabulated. These data along with summaries of data reported in prior years are used to determine if explosion-produced radioactivity has been deposited in environmental waters by the Milrow Event executed Oct. 2, 1969. Comparing tritium levels in post-Milrow water sources to the same water sources pre-Milrow, and to similar but distant water sources post-Milrow, no detectable radioactivity has been deposited in the environment by the Milrow Event. Reference levels of tritium and gross radioactivities were established for various water source types for comparison to future underground nuclear events at Amchitka Island. Typical of these reference values is the reference level of tritium in surface waters of 116 tritium units with an anomaly limit of 218 tritium units. (auth)

42962 (RLO-2225-T-20-7) ^{14}C CONCENTRATIONS IN THE SOUTHERN OCEANS. Fairhall, A. W.; Bradford, P.; Young, A. W. (Washington Univ., Seattle. Dept. of Chemistry). 1970. 4p. Dep. NTIS.

Data for several stations on ELATANIN cruises 38, 39, and 43 are given, where the absolute ^{14}C concentrations are plotted as a non-linear function of depth. An educated guess for the specific radioactivity of the surface ocean prior to nuclear testing gives an estimate for the pre-1950 (natural) ^{14}C concentration of surface waters. Below 2000 m it was assumed that there is yet no perturbation by bomb ^{14}C. These assumptions led to the conclusion that the natural ^{14}C concentration in the southern oceans was $1.42 \pm 0.02 \times 10^9$ atoms/l independent of depth. The influence of bomb ^{14}C to depths of 1000 m was apparent. (P.C.H.)

42963 TRANSPORT AND DEPLETION OF RADIONUCLIDES IN THE COLUMBIA RIVER. Robertson, D. E.; Silker, W. B.; Langford, J. C.; Perkins, R. W. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 66(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42964 PRODUCTION AND RELEASE OF ^{13}N AND ^{18}F FROM POWER REACTORS. Singh, Mike Sohan; Lawrence, Ruby (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 15: No. 1, 80-1(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42965 ENVIRONMENTAL SAMPLING FOR RIVER SEDIMENTS AROUND A NUCLEAR POWER STATION. Hairr, Leland M.; Wrenn, McDonald E. (New York Univ., N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 82-3(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Ecosystems and Food Cycles

Refer also to abstract 43225.

42966 METHOD FOR ASSESSING THE RELATIVE ENVIRONMENTAL IMPORTANCE OF INDIVIDUAL RADIONUCLIDES. Eckart, L. E.; Leonard, J. H. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 1, 81-2(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Radiometric Techniques

Refer also to abstracts 42952 and 42953.

42967 (PAEC(A)-719) CHROMIUM ISOTOPES—^{51}Cr. A Literature Search. (Philippine Atomic Energy Commission, Manila). Oct 1971. 124p. Dep. NTIS (U. S. Sales Only).

References (569) are given to ^{51}Cr in chemistry, earth sciences, engineering, instrumentation, life sciences, metals, ceramics, and other materials, physics (general), physics (high energy), physics (nuclear), and reactor technology. The references are all cited in NSA for the period Oct. 30, 1948 to July 31, 1970. Personal author and corporate author indexes are also included. (P.C.H.)

42968 KRATKII OBZOR PRIMENENIYA IZOTOPOV STRONTSIYA I SVINTSA V GEOLOGII. (Short Survey of Applications of Strontium and Lead Isotopes in Geology). Yashchenko, M. L.; Barshavskaya, E. S. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1971). 140p.

A survey is presented of work both in Russia and abroad on the utilization of Sr and Pb isotopes in resolving questions such as the mechanism of planetary formation, the nature of the earth's crust, and the magmatic center. A wide variety of methods are considered in the acquisition of data for answering the many types of geological questions concerning the earth. The nature of variants in the primeval ratio of Sr isotopes, and the use of the isotopic ratio of Sr and Pb as indicators in the genesis of magmatic rocks were examined. 168 references. (K.S.W.)

42969 APPLICATION OF ^{252}Cf TO THE DETECTION OF HEAVY METALS FOR POLLUTION CONTROL. John, Joseph;

Orphan, V. J. (Gulf Radiation Tech., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 66(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42970 TWO NUCLEAR TECHNIQUES FOR STACK PLUME STUDIES: ISOTOPE RATIO AND SULFUR HEXAFLUORIDE TRACER. Newman, L.; Manowitz, B.; Tucker, W. D. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 69(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42971 AUTOMATIC ANALYSIS OF ATMOSPHERIC AEROSOLS FOR RESEARCH AND MONITORING PURPOSES. Cahill, T. A.; Sommerville, R. (Univ. of California, Davis). Trans. Amer. Nucl. Soc.; 15: No. 1, 70-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42972 GEOLOGICAL INTERPRETATION OF FISSION TRACK AGES. Wagner, Guenther A. (Max Planck Institut fuer Kernphysik, Heidelberg). Trans. Amer. Nucl. Soc.; 15: No. 1, 117 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42973 CALIBRATION OF THE DECAY CONSTANT OF ^{238}U SPONTANEOUS FISSION. Gentner, W.; Storzer, D. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Gijbels, R.; Van der Linden, R. Trans. Amer. Nucl. Soc.; 15: No. 1, 125-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42974 FISSION TRACK ANNEALING BEHAVIOR OF APATITE. Maerk, E.; Pahl, M.; Maerk, T. D. (Institute fuer Atomphysik, Imnsbruck). Trans. Amer. Nucl. Soc.; 15: No. 1, 126-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42975 FISSION TRACK LENGTH REDUCTIONS IN MINERALS AND THE THERMAL HISTORY OF ROCKS. Wagner, G. A.; Storzer, D. (Max Planck Institut fuer Kernphysik, Heidelberg). Trans. Amer. Nucl. Soc.; 15: No. 1, 127-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42976 FISSION TRACK ETCH KINETICS IN GLASSES. Storzer, D. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Trans. Amer. Nucl. Soc.; 15: No. 1, 129(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42977 EFFECT OF IONIC SOLUTIONS ON FISSION TRACK STABILITY IN APATITE. Burchart, Jan; Reimer, G. M. (Univ. of Pennsylvania, Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 1, 129-30(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42978 TERRAIN RADIATION TRANSMISSION THROUGH SNOW COVER. Fritzsche, A. E.; Burson, Z. G.; Burge, D. L. (E G and G, Las Vegas, Nev.). Trans. Amer. Nucl. Soc.; 15: No. 1, 144-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42979 FISSION-TRACK DATING OF APATITES FROM THE CENTRAL ALPS. Wagner, G. A.; Reimer, G. M. (Pennsylvania State Univ., University Park). Ann. Soc. Geol. Belg.; 94: No. 2, 136(1971). (CONF-710953-5).

From European conference of geochronology; Brussels, Belgium (6 Sep 1971).

Apatite concentrates from about 50 localities along a North–South profile through the Aare-massif, Gotthard-massif, Pennine nappes (Simplon area) and the Southern Alps were dated with the fission track method. The measured fission-track ages range between 2 My and 15 My. These ages are younger than the corresponding Rb/Sr mica ages on the same samples previously dated by Jäger et al. Generally, these younger ages can be explained as cooling ages to 125 ± 15°C. The age pattern shows a regional and an altitude dependence and thus appears to be related to the uplift history of this Alpine region. (auth)

42980 PRESENT STATUS OF THE β DECAY IN USE IN GEOCHRONOLOGY. Beckinsale, R. D. (Inst. of Geological Sciences, London); Gale, N. H. Ann. Soc. Geol. Belg.; 94: No. 2, 102-4(1971). (CONF-710953-1).

From European conference of geochronology; Brussels, Belgium (6 Sep 1971).

Naturally occurring long-lived nuclides decaying by β-decay and related processes are ^{40}K, ^{50}V, ^{87}Rb, ^{115}In, ^{123}Te, ^{138}La, ^{176}Lu, and ^{187}Re. Established methods of radiometric age determination are based on the decays $^{40}\text{K} \rightarrow {}^{40}\text{Ar}$, $^{87}\text{Rb} \rightarrow {}^{87}\text{Sr}$, $^{176}\text{Lu} \rightarrow {}^{176}\text{Hf}$ and $^{187}\text{Re} \rightarrow {}^{187}\text{Os}$. Of the rest of these active nuclides the β-branch $^{138}\text{La} \rightarrow {}^{138}\text{Ce}$ is probably potentially more promising than the electron capture branch $^{138}\text{La} \rightarrow {}^{138}\text{Ba}$ because of the relative natural abundances of the daughter nuclides. It appears unlikely that ^{50}V or ^{115}In will ever provide methods of age determination since their decay constants are of the order of 10^{-16} yr^{-1} and 10^{-15} yr^{-1} respectively. (auth)

42981 TRACER STUDIES OF ATMOSPHERIC EXCHANGES BASED ON MEASUREMENTS OF ^{22}Na AND ^{7}BePRODUCED BY COSMIC RAYS. Yasyulonis, R. Yu. (Inst. of Physics and Mathematics, Vilynus, USSR). Liet. Fiz. Rinkinys; 11: No. 3, 517-24 (1971). (In Russian).

The possibility of estimating the vertical macroturbulent diffusion coefficient and sodium-22 flux from stratosphere to troposphere was investigated in terms of cosmogenic sodium-22 and beryllium-7 measurements near the ground level. For vertical turbulent diffusion of the atmosphere, the equilibrium theory with a constant turbulent diffusion coefficient for the whole troposphere, was used. The troposphere is divided into two layers: the lower altitudes up to 4 km height where the washout occurs and the upper altitudes above 4 km height where the washout is absent. The dependence of cosmogenic isotopes formation rate on height was approximated by a parabola. The dependence of beryllium-7 and sodium-22 concentrations in ground-level air and the sodium-22 atom flux from stratosphere to troposphere on turbulent diffusion and washout coefficients has been reviewed. On the basis of the data on washout coefficients in the literature, and of the measurements of sodium-22 and beryllium-7 concentrations carried out in Vilnius in 1969, numerical values of the vertical turbulent diffusion coefficient were estimated. (auth)

42982 SYSTEMATIC AND RANDOM ERRORS IN DUAL GAMMA ENERGY SOIL BULK DENSITY AND WATER CONTENT MEASUREMENTS. Gardner, Walter H.; Campbell, Gaylon S.; Calissendorff, C. (Washington State Univ., Pullman). AT-(451-1-1543). Soil Sci. Soc. Amer., Proc.; 36: No. 3, 393-8(1972).

Soil bulk density and water content may be obtained concurrently through measurement of the attenuation of gamma photons from two different gamma ray sources and simultaneous solution of the resulting attenuation equations. Errors in the soil bulk density and water content measurements result from random emission from the sources, random errors in attenuation coefficients and soil column thickness measurements, presence of a small, higher energy peak in the ^{241}Am spectrum, and counting equipment dead time. Using gamma photons from ^{241}Am at 0.060 MeV and from ^{137}Cs at 0.662 MeV, attenuated in 10-cm soil columns, the standard deviation in both water content and bulk density measurements is primarily due to random emission and is about 0.007 g/cm^3 for 10^6 counts measured in air and about 0.005 g/cm^3 for 2.5×10^6 counts. However, as larger counts are used the precision of measurement of column thickness and soil and water attenuation coefficients becomes limiting. If, by obtaining large counts, the variance due to random emission is reduced to the same magnitude as that associated with measurement of column thickness or attenuation coefficients, precision limit would be about 0.0035 g/cm^3 at midrange values of water content and bulk density. At high count rates instrument dead time corrections are made to get accurate counts. Gamma rays scattered down from the small 0.103 MeV peak in the ^{241}Am spectrum result in attenuation dependent attenuation coefficients for which appropriate corrections must be made. For narrow collimating slits the spatial resolution is only a little greater than slit thickness. Collimator and shielding requirements are shown. (auth)

Site Surveys

Refer also to abstracts 44838 and 44882.

42983 (NVO-1229-174) ANALYSIS OF WATER-LEVEL FLUCTUATIONS IN WELL UAe-1, AMCHITKA ISLAND, ALASKA. Charnell, Robert L.; Feneke, Paul R. (Teledyne Isotopes, Las Vegas, Nev.). Oct 1971. Contract AT(29-2)-1229. 28p. Dep. NTIS.

An analysis was made of the water-level fluctuations in hydrotest hole UAe-1 on Amchitka Island, Alaska. These fluctuations are composed primarily of a short-term component induced by ocean tides and a long-term component induced by variations in atmospheric pressure. The water level in the well responds as if the well is completed in one or more confined aquifers. The tidally induced response is the result of loading the confined aquifer; there is little or no transfer of water between the ocean and aquifer due to tidal pumping. The field data were also used to determine a value for the hydraulic conductivity. Assuming that flow is primarily through fractures, the hydraulic conductivity value is about 0.03 m/day. This agrees well with pumping test data. (auth)

42984 (NVO–1229-178) DETERMINATION OF A COEFFICIENT OF DISPERSION UNDER FIELD CONDITIONS: INTERIM REPORT. Hackenberry, Paul S.; Nork, William E.; Essington, Edward H. (Teledyne Isotopes, Las Vegas, Nev.). Oct 1971. Contract AT(29-2)-1229. 99p. Dep. NTIS.

Dispersion of radioactive or chemical contaminants introduced into ground-water aquifers reduces the maximum concentration of the contaminant while spreading the contaminant in a larger volume of ground-water aquifer. The degree of dispersion in desert alluvium, the medium in which many underground nuclear explosions are conducted, is presently unknown. The prime objective of this study is to field test theoretical and laboratory models describing two-dimensional dispersion of a contaminant during flow through porous media and to derive a coefficient of dispersion representative of desert alluvium. A field site was selected to study dispersion. The site was developed for tracing ground-water flow under essentially undisturbed hydrogeologic conditions. As part of site development, hydrogeology and hydraulics of the site were investigated. The study site appears to meet the criteria for field determination of the coefficient of dispersion. Preliminary results indicate significantly higher velocities than expected for a shallow alluvial aquifer. Measured ground-water flow velocities range from 2.5 to 6.4 meters per day from two tracer studies. Ground-water flow direction at the site is to the south-southwest. Preliminary results indicate a significantly greater rate of lateral dispersion than present theory would predict. (auth)

Thermal Effluents

Refer also to abstracts 42915, 44839, 44840, 44850, 44868, 44869, 44880, 44890, and 44916.

42985 ENVIRONMENTAL EFFECTS OF PRODUCING ELECTRIC POWER FROM GEOTHERMAL RESOURCES. Bowen, Richard G. (Dept. of Geology and Mineral Industries, Portland, Oreg.). Trans. Amer. Nucl. Soc.; 15: No. 1, 17-18(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42986 ESTIMATING THERMAL INFLUENCE FROM OFFSHORE DISCHARGES. Miner, Russell M. (Pacific Gas and Electric Co., Emeryville, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 76(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42987 APPLICATION OF PROBABILISTIC METHODS TO THERMAL LOADING PROBLEMS. Brown, H. L.; Nwude, J. K.; Klanian, P. S.; Graybill, J. E.; Leifer, M. P. (Drexel Univ., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 1, 77(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42988 USE OF WATER-QUALITY SIMULATION MODELS IN THE ANALYSIS OF THE THERMAL EFFECTS PROBLEM. Gritton, E. C.; Kvitky, J.; Leendertse, J. J. (Rand Corp., Santa Monica, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 77-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

42989 FLUID MECHANICS OF HEAT DISPOSAL FROM POWER GENERATION. Harleman, Donald R. F. (Massachusetts Inst. of Tech., Cambridge); Stolzenbach, Keith D. Annu. Rev. Fluid Mech.; 4: 7-32(1972).

An outline of the state of the art in predicting the flow and temperature distribution due to a heated discharge of condenser cooling water into an adjacent water body is presented, with an emphasis on the understanding of the fluid mechanics and thermodynamics of the once-through cooling process. The exclusion of direct cooling devices (cooling towers or spray ponds) does not imply that there have been no advances in the understanding of the fluid flows and heat transfer in these cases. However, the problems connected with closed-loop cooling processes are primarily of the operational and engineering-design type and are not related significantly to changes in the natural environment. In contrast, the prediction of temperature rises and flows induced by a heated discharge not only involves an understanding of a variety of fundamental fluid phenomena but is also a prerequisite to the evaluation of environmental changes. (auth)

42990 POWER PLANT EFFLUENT: THERMAL POLLUTION OR ENERGY AT A BARGAIN PRICE? Lusby, W. S.; Somers, E. V. (Westinghouse Research Labs., Pittsburgh). Mech. Eng.; 94: No. 6, 12-15(Jun 1972).

A plan for use of electric power plant reject heat is discussed. It is noted that many uses for the reject heat can be found in winter. Such heat energy can also be used in summer in lithium bromide–water absorption refrigeration systems to cool homes and offices. Methods of optimizing energy centers are discussed along with future prospects. (J.R.D.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 43652.

General Detectors and Monitors

Refer also to abstracts 43401, 43670, 43671, 44302, 44635, 44952, 44985, 44993, and 45008.

42991 (CISE-R-247) AUTOMATIC SAMPLE CHANGING APPARATUS FOR 5 PROGRAMS. **Guandalini, S.; Pirovano, B. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1967. 20p. (In Italian). Dep. NTIS (U. S. Sales Only).**

The construction and operation characteristics of an automatic device for the scanning of irradiated activation detectors are described. Five different programs of scanning may be chosen by the operator. (auth)

42992 (CISE-R-249) PROGRAMS FOR THE AUTOMATIC WORKING OUT OF NUCLEAR MEASUREMENTS. **Taddei, F. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1967, 82p. (In Italian). Dep. NTIS (U. S. Sales Only).**

The digital computer codes PIROGA, FRESCONE and PROF are described. The purpose of these codes is the elaboration of data of γ countings from activation detectors, performed with the automatic system described in report CISE R-247. The Fortran IV IBM version of the codes presented is completed and improved with respect to the Fortran I version, described in report CISE R-190. Also, the ESSE–ESSE code, for the computation of the selfshield and detector intercalibration coefficient, is presented; this is an auxiliary code for the data elaboration codes. (auth)

42993 (FRNC-R-4, pp 127-32) PRACTICAL APPLICATIONS OF SPARK CHAMBERS. **Riviere, R.; Cioppani, F.; Desgrez, A.; Kellershohn, C. (CEA, Orsay, France). (In French).**

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

Industrial spark chambers are well suited to measurements on the radiation emitted by ^{125}I, which consists partly of Te K x-ray photons having a mean energy of 27.3 keV. Various studies in which ^{125}I and ^{131}I were used under the same conditions for thyroid scintigraphy indicate the advantages of ^{125}I, in particular with respect to resolution and contrast. The thyroid images obtained were of remarkable quality, due to an excellent geometrical resolution. A 20 mm thick Ag collimator with 1 mm diameter holes can further improve the results. The development of a chamber containing gas at a higher pressure might permit a higher detection efficiency. (France)

42994 (FRNC-R-4, pp 133-5) ASSEMBLY FOR SUBTRACTIVE SCANNING AND ITS APPLICATION TO STUDYING THE PANCREAS. **de Saint-Laurent, J. (Hopital Saint-Antoine, Paris); Desgrez, A. (CEA, Orsay, France). (In French).**

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

Scintigraphy studies of the pancreas have benefited from a new method enabling the subtraction of two scintigraphic images obtained with different radioelements to be performed. The apparatus established fulfills the following conditions: performs the subtraction, while at the same time conserving the parameters defining the operation; possesses an adaptability for use with a classical sweeping scanner; and possesses the maximum economy. Practical examination with this equipment allowed the pancreas to be very well defined. (France)

42995 (FRNC-R-4, pp 140-3) MULTICHANNEL EXPLORATION AND STATISTICAL ACCURACY: A NEW METHOD FOR DATA ACQUISITION. **Guihard, R.; Guihard, D.; Arnaud, P. (Univ., Nantes, France). (In French).**

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

Valid multichannel functional exploration is subject to the following two conditions: the information must be faithfully reproduced (i.e., the most rapid sequences must be followed and faithfully reproduced); a permanent record of the information must be possible; and the accuracy obtained must be satisfactory. Although classical methods involving small time constant integrators fulfill these conditions, digitization of the information using all the multichannel analyzers is to be preferred. Two solutions are possible: sequential analysis and the loading-unloading process. The latter process permits a single block memory to be used in the digitization of the information collected from several simultaneous exploration channels. (France)

42996 (FRNC-R-4, pp 144-8) PROGRAM FOR METABOLIC EXPLORATION BY WHOLE-BODY COUNTING. **Gongora, G. (Institut du Radium, Paris); Gongora, R.; Jammet, H.; Pages, J. P.; Marchadier, B. (In French).**

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

Metabolism studies have only recently provided useful information by direct measurements of the total body burden made using γ spectrometry. These methods imply the exploitation of the energy spectra and thus the exploitation of a large amount of data necessitating certain calculations. For the above reasons, a computer is well suited for handling the information collected. The development of the associated computer programs had to take into account: the object of the exploitation; the type of equipment used to measure the incorporated activities and identify the radioelements; the examination technique used. The programs are written in Fortran IV. The handling of the information (energy spectra) implies two types of output. The first leads to a direct reading of the spectra from an oscilloscope and utilizes a recorder and a numerical printing machine. The second type of output consists of recording the information on magnetic or perforated tapes. (France)

42997 (FRNC-R-4, pp 151-5) PROGRESS IN NUCLEAR MEDICINE: USE OF A MULTIPARAMETER ANALYZER. **Blanquet, P. (Hopital Saint-Andre, Bordeaux, France); Beck, C.; Safi, N.; Ducassou, D.; Basse-Cathalinat, B.; Magneron, P.; Fleury, J. (In French).**

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

A multiparameter analyzer unit may be used to facilitate the exploitation of information obtained from scintillation cameras. The equipment may be used in a variety of different ways. The simplest method provides a scintigraphic image, which can be treated in various different ways. The most complex utilization leads to the direct establishment of curves representing the changes in the radioactivity level as a function of time for various areas in the region being explored. Numerous applications are possible. The principal applications are outlined: simple scintigraphy giving a permanent readout scintigraphy followed by an integration which allows the functional value of symmetric organs to be numerically estimated; subtraction scintigraphy, a method which has facilitated the development of pancreatic scintigraphy; sequential scintigraphy; quantitative scintigraphy; and functional exploration. (France)

42998 (FRNC-R-4, pp 195-208) WHOLE-BODY COUNTER USED AT LIEGE, CALIBRATION FOR ^{40}K AND ^{137}Cs. PRELIMINARY CLINICAL RESULTS. **Delwaide, P. (Univ., Liege). (In French).**

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

The prototype whole-body counter used by the University of Liege is in accordance with the European plan for a device of this type. It allows the contents of K and Cs to be accurately measured in human subjects using a simple mathematical treatment. Preliminary studies involved investigating the K and Cs contents in normal reference subjects. The method also allows the total quantities of K to be investigated under various physiopathological conditions. Interesting results were obtained in the three following categories: cirrhosis, diabetes, and renal insufficiencies. (France)

42999 (JINR-P13-6380) ELECTRONICS FOR PROPORTIONAL WIRE CHAMBERS (REVIEW). **Turala, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 39p. (In Russian). Dep. NTIS (U. S. Sales Only).**

The specifications for the readout electronics and some readout systems for proportional wire chambers are considered. The electronics circuits and logic organization are described for the case of using proportional wire chambers for coordinate measurements or selective triggering. (43 references) (auth)

43000 (JINR-P13-6388) DOUBLE MULTIPLEX SYSTEMS FOR PARTICLE DETECTION. **Soroko, L. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).**

Principle of the double multiplex systems is developed by the example of a device consisting of a multiplex target and a multiplex scintillation counter. There are presented the values of weakened background errors which vary in such a way (in the observed range of angles) that the errors in the central areas are smaller than those in the edge areas. (auth)

43001 (JINR–P13-6449) NEW PARTICLE DETECTOR–CRYSTAL FILAMENT COUNTER. Pisarev, A. F.; Pisarev, V. F.; Revenko, G. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

A new crystal filament particle counter has been designed and investigated. The counter has a cylindrical cathode with a conducting filament strained along its axis. The filament is frozen into the solid crystal working substance. The properties of the counter with the crystal argon, xenon, and methane are studied. It is determined that the amplitude characteristics of the Ar and Xe counters have three typical regions: ionization, proportional and the region of saturation. The factor of the proportional amplification is about 150. The counter characteristic curve has a plateau with a weak slope and considerable extension (~3 kV). A mobility of the positive charges in solid argon of 10^{-1} cm^2 V^{-1} sec^{-1} was observed. The mobility in solid xenon is $10^{-1} - 10^{-2}$ cm^2 V^{-1} sec^{-1}. Satisfactory results for the crystal methane counter were not obtained. (auth)

43002 (JINR–P13-6450) INVESTIGATION OF THE FILAMENT PARTICLE COUNTER WITH GAS AND LIQUID FILLING. Pisarev, A. F.; Pisarev, V. F.; Revenko, G. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

Operation of the filament particle counter filled with argon, xenon, methane and mixtures of methane and argon in the liquid and gaseous state up to 100 atm. pressure was investigated. It was determined that the operation of the counter filled with pure gases at high pressure is rather unstable. Gas mixtures show quite satisfactory characteristics up to the pressure of 100 atm. The data on the counter with liquid argon and xenon filling have been confirmed, and data on the operation of the counter filled with liquid methane and liquid mixtures of methane and argon are given. (auth)

43003 (LA–4972) CHARGE-SENSITIVE PREAMPLIFIER FOR USE WITH LARGE PROPORTIONAL COUNTER ARRAYS. East, Larry V.; Swanson, James E. (Los Alamos Scientific Lab., N. Mex.). Jun 1972. Contract W-7405-eng-36. 7p. Dep. NTIS.

A charge-sensitive preamplifier developed for use with large arrays of proportional counters is described. Positive feedback is utilized to essentially eliminate charge sensitivity dependence upon input capacity. The preamplifier operates from a single + 12 V power source, and its output is linear to about 4 V when operated into a 100-ohm load. (auth)

43004 (RD/B/N–801) ERRORS IN INTERPRETING THE EFFECT OF REMOVING END CAPS FROM "BETA–GAMMA" MONITORS. Thompson, I. M. G.; Shipton, R. G. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jun 1967. 9p. Dep. NTIS (U.S. Sales Only).

Measurements made with a thin walled ionization monitor of the exposure rate from collimated and uncollimated gamma sources are reported. The interpretative difficulties of measuring beta radiation with such chambers are discussed. (auth)

43005 TWO ACTIVE HIGH-INTENSITY NEUTRON DETECTORS. Friddell, K. D.; Lowrey, A. R. (Boeing Co., Seattle). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 190-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Two neutron detectors were designed to have a high ratio of neutron to gamma ray sensitivity for time resolved measurements of intense neutron pulses. One detector utilized a thin aluminum foil sandwiched between two fission foils in an evacuated chamber. The foils were thick compared to the range of fission fragments. Fission fragments passing through the surfaces created secondary emission electrons, producing a large neutron induced signal compared to the gamma-ray induced response. The second detector utilized a pair of silicon fission fragment detectors exposed to a ^{235}U foil at the opposite end of an evacuated tube. One silicon detector was exposed to both the gamma ray background and the neutron induced fission fragments from the foil, while the second silicon detector was shielded from the fission fragments by a thin aluminum shield, but otherwise was exposed to the same background radiation. Thus, the time resolved neutron signal could be recorded by observing the differential signal from the two silicon detectors with an oscilloscope and camera. The approximate neutron sensitivities of the two detectors were calculated and compared to the experimentally measured values obtained from exposures to thermal and fission spectrum neutrons. (auth)

43006 DOSIMETER FOR RADIOACTIVE ISOTOPES. Mauderli, W.; Lorenz, E. (Univ. of Florida, Gainesville). Fortschr. Geb. Roentgenstr. Nuklearmed.; 116: No. 5, 663-6(1972). (In German).

A dosimeter which uses an ionization chamber as detector is described. The total activity of a test sample as well as the volume of a radioactive solution which must be administered to a patient for a given activity can be determined. Two methods which permit this type of determination are described. (auth)

43007 SCINTILLATION EFFICIENCY OF SOLUTIONS OF EUGENOL AND METHYLEUGENOL IN XYLENE AND TOLUENE. Kucharski, Jan; Wasniewski, Tadeusz (Higher Engineering School, Bialymstok, Poland). Nukleonika; 16: No. 7-8(1971). (In Polish).

The γ radiation of a ^{60}Co source was used to study the scintillation efficiency of eugenol ($C_{10}H_{12}O_2$) and methyleugenol ($C_{11}H_{14}O_2$) solutions in toluene and xylene as a function of concentration. Using anthracene crystals as reference, it was found that a maximum of 5.4% is reached for a 0.1% solution of eugenol in toluene and a 0.75% solution of methyleugenol in xylene. Tests were carried out also with calamus oil. (TTT)

43008 CALCULATIONAL MODEL FOR SELF-POWERED NEUTRON DETECTOR. Warren, H. D. (Babcock and Wilcox Co., Lynchburg, Va.). Nucl. Sci. Eng.; 48: No. 3, 331-42(Jul 1972).

A calculational model is presented for the self-powered neutron detector of the type used in nuclear reactor cores. The model accounts for the neutron capture rate for beta-decaying nuclei, the electron escape probability from the emitter of the detector, and the effect of the insulator on the sensitivity of the device. Calculated unit sensitivities to thermal neutrons are presented as functions of emitter diameters and insulator thicknesses for rhodium and vanadium emitters having cylindrical geometries. The calculated values are compared with experimental values. (auth)

43009 DOUBLE FILTER TECHNIQUE FOR THE INVESTIGATION OF THERMAL-NEUTRON SPECTRA. Antonini, D.; Omicini, E.; Pistella, F. (CNEN, Rome). Nucl. Sci. Eng.; 48: No. 3, 281-99(Jul 1972).

A technique is presented for the evaluation by activation methods of the thermal resonance reactions in a system with thermal resonance absorbers; the method consists of measuring twice the ratios between the activity of a detector irradiated bare and that of a detector covered by a proper filter. These measurements can be useful in the analysis of spectral effects in plutonium fueled lattices. For instance, using a gadolinium filter and a cadmium filter the two resulting cutoff energies (0.2 and 0.6 eV, respectively) can be obtained such as to enclose the resonance of ^{239}Pu at 0.3 eV. A calculational model to be used in connection with available cross section libraries is described, and a detailed investigation is presented on the behavior of gadolinium filters for detectors having resonances in the thermal energy range. Preliminary applications of the calculational model are presented whence indications are obtained concerning the choices of the detectors and of the filter thicknesses. The feasibility of the technique is shown from the experimental standpoint and the technique is applied by measurements in a neutron system where the spectrum is well known. The reliability of the calculational model adopted is also shown, since for different detectors and for different filter thicknesses the experimental values agree well with the corresponding calculated results. (auth)

43010 SEMICONDUCTOR DETECTORS IN NUCLEAR MEDICINE. Palms, John M. (Emory Univ., Atlanta). Trans. Amer. Nucl. Soc.; 15: No. 1, 40(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43011 NUCLEAR MEDICINE APPLICATIONS OF MULTIWIRE PROPORTIONAL CHAMBERS. Kaufman, Leon (Univ. of California, San Francisco). Trans. Amer. Nucl. Soc.; 15: No. 1, 41-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43012 LOW-LEVEL RADIONUCLIDE SURVEILLANCE SYSTEMS USING MULTICRYSTAL DETECTORS. Walker, David M. (Georgia Inst. of Tech., Atlanta); Fishman, Gerald J. Trans. Amer. Nucl. Soc.; 15: No. 1, 67-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43013 RECENT DEVELOPMENT IN THE IDENTIFICATION OF HEAVY NUCLEI WITH SOLID-STATE TRACK DETECTORS. Maurette, M. (Institut de Physique Nucleaire, Orsay, France). Trans. Amer. Nucl. Soc.; 15: No. 1, 115-16(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43014 TWO TECHNIQUES TO INCREASE CONTRAST OF TRACK ETCH NEUTRON RADIOGRAPHS. Morley, James A. (Plum Brook Station, Sandusky, Ohio). Trans. Amer. Nucl. Soc.; 15: No. 1, 120(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43015 IMPROVED SENSITIVITY AND CONTRAST, TRACK ETCH THERMAL-NEUTRON RADIOGRAPHY. Berger, H.; Lapinski, N. P. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 123-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43016 SPECIAL GLASSES AS ENERGY DETECTORS FOR FISSION FRAGMENTS. Fiedler, G.; Schreck-Koellner, H. (Univ., Giessen, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 1, 128-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43017 NEUTRON RADIOGRAPHY WITH A MULTIWIRE PROPORTIONAL CHAMBER-PERFORMANCE AND PROJECTIONS. Kaplan, Selig (Univ. of California, Berkeley); Valentine, Kenneth; Kaufman, Leon; Perez-Mendez, Victor. Trans. Amer. Nucl. Soc.; 15: No. 1, 140-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43018 REDUCED STATISTICAL UNCERTAINTIES IN COUNTING SHORT-LIVED RADIOACTIVE ISOTOPES. Rogers, V. C. (Brigham Young Univ., Provo, Utah); Sandquist, G. M. Trans. Amer. Nucl. Soc.; 15: No. 1, 154-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43019 MULTIPLE-USE, MULTIPLE-DETECTOR PASSIVE SAFEGUARD SYSTEM. Chanda, R. N.; Deal, R. A.; Cartwright, D. R. (Dow Chemical Co., Golden, Colo.). Trans. Amer. Nucl. Soc.; 15: No. 1, 159(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43020 NEW MICROMINIATURE BETA-GAMMA DETECTORS FOR CONTINUOUS MEASUREMENT IN VIVO OF HIGH AND LOW INTENSITIES. Anton, Nicholas G. (EON Corp., Brooklyn). Trans. Amer. Nucl. Soc.; 15: No. 1, 170(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43021 EVALUATION OF SELF-POWERED DETECTORS IN EBR-II. Price, C. C.; Karvinen, J. R. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 366 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43022 FORMULATION OF THE GAMMA PILEUP EFFECT IN FISSION COUNTERS. Roux, D. P. (Oak Ridge National Lab., Tenn.); Robinson, J. C. Trans. Amer. Nucl. Soc.; 15: No. 1, 423(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43023 PARTICLE NET. Charpak, Georges (European Organization for Nuclear Research, Geneva). Sci. Progr. Decouverte; No. 3441, 8-15(Feb 1972). (In French).

Multiwire proportional chambers are discussed. These chambers resemble other detectors with regard to their very fast resolution time, sensitivity to the magnetic field, and detection efficiency. Numerous applications have already been found, notably in medicine, and more generally for the study of γ rays. (France)

43024 ELECTRONIC EQUIPMENT FOR MEASURING SMALL CURRENTS. Prigent, Raymond; Bouet, Joseph (CEN, Fontenay-aux-Roses, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 3, 1-6(Jul 1971). (In French).

A dc amplifier for measuring small currents (10^{-13} to 10^{-15}A) is presented, which is suitable to be used in conjunction with various detection devices. The apparatus consists of a basic amplifier unit and the appropriate ht supply. In order to facilitate the operation of dielectric liquid ionization chambers, a stabilized 5000 volt ht supply (replaceable by a variable ht supply) is incorporated in the casing. An appropriate preamplifier device connects the amplifier to the detector. This preamplifier may be connected to the basic amplifier unit by 50 meters of cable. The assembly enables the absorbed dose rate and integration measurements of the dose absorbed to be made. The measurements cover a dynamic range of 10^5, the galvanometer operating at full scale deflection. The setup used allowed currents between 10^{-12} and 10^{-7}A to be measured. For absorbed dose measurements (integration), different values of capacitance allowed a range of 10^5 to be covered. The assembly is compact, portable, and easy to use. (France)

43025 APPLICATIONS OF TECHNIQUES DEVELOPED IN HIGH ENERGY RESEARCH CENTERS FOR MEDICAL AND DOSIMETRY PROBLEMS. Rindi, A. (Univ. of California, Berkeley). Minerva Fisiconucl.; 15: No. 4, 159-67(Oct-Dec 1971). (In Italian).

Health physics workers who are accustomed to the usual techniques in connection with high energy accelerators are already familiar with devices such as the Vidicon photocathode system, the acoustic system, the magnetic memory chamber, and the magnetostriction chamber. Spark chambers of various types are described, and their uses in medicine and dosimetry are outlined. Source localization systems for x or gamma rays, equipped with collimators and scintillators, for the human body are discussed. In dosimetry, neutron spectrometry instruments are already commercially available to measure energy spectra from 20 eV to 150 MeV. (K.S.W.)

43026 1971 NUCLEAR SCIENCE SYMPOSIUM AND NUCLEAR POWER SYSTEMS SYMPOSIUM, SAN FRANCISCO, CALIFORNIA, November 3–5, 1971. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 1-909(Feb 1972). (CONF-711111).

Separate abstracts were prepared for 100 of the papers presented at these symposia. Abstracts for 34 other papers have already appeared in NSA; for abstracts of these papers see CONF-711111 in the Report Number Index. An additional paper, on Li driftability and precipitation in Si, was not included in the subject scope of NSA. (R.W.R.)

For abstracts of individual papers see: 42710–42712, 42728, 42801, 42944, 42945, 42950, 42955, 42956, 43027–43046, 43082–43096, 43105–43111, 43116, 43117, 43156–43158, 43173–43191, 43687–43689, 44382–44385, 44505, 44548, 44605, 44638–44644, 44759–44762, 44770, 44996, and 45008.

43027 AVALANCHE DETECTOR ARRAYS FOR IN VIVO MEASUREMENT OF PLUTONIUM AND OTHER LOW-ACTIVITY, LOW-ENERGY EMITTERS. Moldofsky, Philip J. (General Electric Co., Philadelphia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 55-63(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Arrays of silicon avalanche detectors are being used for in vivo detection and measurement of low-energy radiation in very small activities at room and body temperatures. Plutonium may be measured (via the 13.5- to 20-keV daughter uranium L x rays) with an array of three 1 cm^2 avalanche detectors in the esophagus, by examining the thoracic lymph nodes which accumulate inhaled PuO$_2$. The three detectors used in this array together provide uniformity of sensitivity to a source at any angle around the longitudinal axis of the array; by using three independent signal processing systems, the array can also provide localization information. Plutonium scratches and puncture wounds may be inspected for contamination, and the plutonium may be localized using a specially fabricated ⅛-inch-diameter avalanche detector. With this configuration, the Minimum Detectable Amount (MDA) of ^{238}Pu (84% confidence level and four minute count) measured through 2 mm of tissue is 1 nCi. Early results of improved uniformity and resolution with the avalanche detector have shown promise of increased efficiency per unit area of detector face. A step toward unambiguous detection by making better use of the nanosecond speed of avalanche is described. (12 figures, 2 tables) (auth)

43028 GAMMA-RAY PROBE FOR THE DETECTION OF OCULAR MELANOMAS. Knoll, G. F.; Lieberman, L. M.; Nishiyama, H.; Beierwaltes, W. H. (Univ. of Michigan, Ann Arbor). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 76-80(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A specially designed scintillation probe was assembled and applied in a promising diagnostic study of malignant melanoma in the human eye. When used in conjunction with a new radiopharmaceutical agent recently developed at The University of Michigan, ^{125}I-labeled chloroquine analog, the probe permits simple and nonsurgical gamma-ray counting as a substitute for more elaborate techniques required in ^{32}P beta scanning for the same purpose. Preferential uptake of the agent in ocular melanomas has been previously reported using a modified 5-inch NaI (Tl) crystal scanner as the detector. A substantial improvement in both sensitivity and reproducibility was realized by substituting a hand-held probe placed in contact with the patient's closed eyelid. The counting rate over each eye is followed for a period ranging from 3 to 21 days after dosage. A melanoma in one eye gives rise to an enhanced rate over that eye. Data are presented on a total of 12 patients, including two with confirmed ocular melanomas. In both of these cases, the involved eye consistently shows a significantly greater activity than the opposite eye. In the remaining cases, considered "negative", measured eye-to-eye asymmetries are much lower, and a measure of the variance associated with these cases is presented. (5 figures, 1 table) (auth)

43029 PCD LIFETIME MEASUREMENTS AS A FUNCTION OF TEMPERATURE IN DETECTOR-GRADE AND IMPURITY-DOPED GERMANIUM. Schoenmaekers, W. K.; Van Ouytsel, J. I.; De Laet, L. H. (Metallurgie Hoboken-Overpelt, Olen, Belg.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 279-88(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

It is shown, theoretically and experimentally, that PCD lifetime measurements, as a function of temperature in p–Ge, may be used to determine the concentration, the trap energy, and capture cross sections for electrons, of single- and multilevel impurities. (12 figures) (auth)

43030 SEARCH FOR DEEP TRAP LEVELS IN Ge(Li) DETECTORS. McMath, T. A.; Sakai, Eiji (Chalk River Nuclear Labs., Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 289-94(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Attempts to measure the level of deep electron trapping centers in Ge(Li) detectors were made by observing the variation of pulse amplitude with temperature over a wide temperature range. The mean time τ_D for the reemission of a trapped carrier from a given level decreases exponentially with increasing temperature; as τ_D becomes shorter than the amplifier time constants, the pulse amplitude should show an increase over a narrow temperature interval. No such transition was observed between 80 and 160 K. It is concluded that the main electron trap is deeper than 0.175 eV. (5 figures, 1 table) (auth)

43031 BASIC LIMITATIONS IN FABRICATION OF RADIATION DETECTORS BY GAMMA COMPENSATION OF GERMANIUM. Llacer, J. (Brookhaven National Lab., Upton, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 295-315(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The process of γ compensation as a method for fabricating Ge radiation detectors was studied in some detail. Particular attention was focused on the energy distribution and concentration of the levels created by the γ irradiation, on the differences between crystals before and after irradiation, on the field configurations in junctions with deep traps, and on obtaining the carrier-trapping cross sections due to irradiation. It was found that crystals with impurity concentrations of 5×10^{10} to 5×10^{12} $(\mathrm{cm})^{-3}$ can be quite different from each other before and after irradiation. Compensation of n-type material to a very low n- or p-type residual conductance is always feasible, although the compensation mechanism for devices at near thermal equilibrium is different from that of diodes with bias applied. From measurements with several compensated detectors, it was found that effective hole-trapping cross sections of 10^{-12} to 10^{-13} cm^2 are commonly obtained: these result in poor resolution even with initial materials of the highest purity. One exceptional crystal gave excellent resolution after compensation but suffered catastrophic failure with a small amount of overirradiation. This particular result suggested a two-threshold mechanism, which, in combination with the knowledge gained from the calculation of field distributions in junctions with deep levels, may explain the results observed. Emphasis is then placed on the apparent need for extreme crystal uniformity, which, if confirmed, will result in declaring the γ-compensation process impractical for the fabrication of radiation detectors. (20 figures, 3 tables) (auth)

43032 RECENT DEVELOPMENTS IN GERMANIUM AND SEARCH FOR A CORRELATION WITH Ge(Li) DETECTOR CHARACTERISTICS. Van Ouytsel, J. I.; De Laet, L. H.; Schoenmaekers, W. K. (Metallurgie Hoboken-Overpelt, Olen, Belg.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 316-22(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Recent developments in germanium are presented. Existing theories about trapping in Ge(Li) detectors are criticized. Major improvements in quality were achieved. Chemical impurities, as a possible source of electron trapping, are discussed. (auth)

43033 SILVER AS A LIFETIME KILLER IN p–Ge AND A HOLE TRAP IN Ge(Li) DETECTORS. Schoenmaekers, W. K. (Metallurgie Hoboken-Overpelt, Olen, Belg.); Henck, R. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 329-35(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The temperature dependence of the lifetime in silver-doped p-Ge, as measured by the PCD method, is shown to be in agreement with a model for recombination through multivalent flaws. New values of capture cross sections were determined ($\sigma_n^0 = 1.5 \times 10^{-14}$ cm^2, $\sigma_n^- = 0.75 \times 10^{-16}$ cm^2). Lifetimes of electrons and holes were also measured on a silver-doped Ge(Li) detector, by means of two techniques, by using a collimated beam of γ rays (^{137}Cs). Silver causes preferential hole trapping and, therefore, cannot be responsible for the preferential electron trapping usually observed. (8 figures, 2 tables) (auth)

43034 PREFERENTIAL ELECTRON TRAPPING BY Te ATOMS IN Ge(Li) DETECTORS. Henck, R. (Centre de Recherches Nucleaires, Strasbourg); Schoenmaekers, W. K. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 336-40(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

In germanium, Te is a double donor. Te, when capturing one electron, is still repulsive for holes, and has no influence on the recombination lifetime of electrons in p-type Ge. In accordance with what one should expect, measurements with collimated beams of γ rays show that Te is a preferential electron trap. (auth)

43035 IMPROVED INFRARED-RESPONSE MEASUREMENTS IN SEMICONDUCTOR NUCLEAR RADIATION DETECTORS. Sher, A.H.; Keery, W. J.; Dyson, H. E. (National Bureau of Standards, Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 341-4(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

An infrared response technique was developed which was shown to yield more detailed spectra than previous techniques and which can be used to identify more specifically energy levels arising from unwanted impurities and defects in semiconductor diodes used as nuclear radiation detectors. The presence of known impurities in germanium detectors, both lithium-compensated and high-purity (uncompensated), was confirmed using this technique. Such impurities include copper, gold, and iron. Features in the spectra associated with crystalline defects were also identified. (6 figures) (auth)

43036 SUBNANOSECOND RISE TIME CHEVRON MICROCHANNEL PLATE PHOTOMULTIPLIER TUBE. Catchpole, C. E. (Bendix Research Labs., Southfield, Mich.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 360-1(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A sub-nanosecond response time photomultiplier tube, which uses a chevron microchannel plate for electron multiplication, is discussed. Fabrication of the device is described, the advantages of using a microchannel plate multiplier being stressed. Measurements of the tube performance are given. (4 figures) (auth)

43037 PRECISION MONITORING OF INTENSE BREMSSTRAHLUNG PULSES USING SELF-POWERED DETECTORS. Hewitt, J. S.; Jefford, J. D. (Univ. of Toronto). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 379-83(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Self-powered detectors are potentially valuable in the monitoring and control of the intense bremsstrahlung beams produced by clinical and other linear electron accelerators. The design, construction, and operation of special self-powered detectors for indicating the centroid of the bremsstrahlung beam profile are described. (5 figures) (auth)

43038 IMPROVED AMPLITUDE- AND RISE-TIME-COMPENSATED TIMING WITH Ge DETECTORS. Cho, Z. H.; Chase, R. L. (Brookhaven National Lab., Upton, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 451-60 (Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The energy range over which signal timing can be made nearly independent of amplitude and rise time was extended downward by about an order of magnitude by employing dual priming of a zero-crossing discriminator. By introducing another coarsely compensated timer between the high-resolution timer and its priming leading-edge discriminator, one can optimize the timing accuracy without sacrifice of dynamic range. Time walk of less than 1 ns was achieved from about 20 keV to over 1 MeV. (12 figures, 1 table) (auth)

43039 INTERLABORATORY DEVELOPMENT OF AN INTEGRATED CIRCUIT FOR MULTIWIRE PROPORTIONAL CHAMBERS. Larsen, R. S. (Stanford Univ., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 483-94(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The history and current status of an interlaboratory program to develop an integrated circuit for multiwire proportional chambers are reviewed. Specifications and circuit diagrams are discussed. Two manufacturers appear close to completing satisfactory prototypes. (15 figures, 3 tables) (R.W.R.)

43040 PULSE-SHAPE DISCRIMINATORS FOR NaI/CsI PHOSWICH DETECTORS. Wilson, S.; Baker, G.; Schlansker, K. (Bendix Aerospace Systems Div., Ann Arbor, Mich.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 512-19(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Three different types of low-power pulse-shape discriminators were designed and built for applications in space experiments. Their dynamic range, ability to separate mixtures, and sensitivity to photon statistics were measured using a phoswich detector and an LED pulser which simulates the scintillation signals. The performance of the discriminators compares favorably with an analytic investigation. (10 figures, 1 table) (auth)

43041 CIRCUITS FOR PULSE RISE-TIME DISCRIMINATION IN PROPORTIONAL COUNTERS. Culhane, J. L.; Fabian, A. C. (University Coll., London). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 569-78(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

It is possible to distinguish x-ray events from particle events in proportional counters on the basis of the difference in rise time between the pulses that result from both kinds of event. A number of different circuit configurations for achieving rise-time discrimination were evaluated, and their performances were compared. Rise-time spectra of ^{55}Fe and ^{60}Co were obtained in several different gas mixtures. (11 figures, 2 tables) (auth)

43042 UHURU X-RAY INSTRUMENT. Jagoda, N.; Austin, G.; Mickiewicz, S.; Goddard, R. (American Science and Engineering, Cambridge, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 579-91(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

On 12 December 1970, the UHURU (SAS-A) x-ray observatory was launched into equatorial orbit with the prime mission of conducting an all-sky survey of astronomical x-ray sources with intensities of 5×10^{-5} Sco-X1 or greater. Featuring two large-area proportional counter detector systems, the experiment has operated without a failure and is returning information of great interest to the scientific community. The system design and performance are presented in engineering terms. Descriptions are presented of the signal processing, aspect determination, in-flight calibration, command, and telemetry formatting systems. (19 figures) (auth)

43043 ALL-SKY X-RAY MONITOR FOR THE UK-5 SATELLITE. Desai, U. D.; Holt, S. S. (Goddard Space Flight Center, Greenbelt, Md.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 592-5(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

An x-ray imaging system using a pin-hole camera and a position-sensitive proportional counter at the image plane was designed for an all-sky x-ray monitor for the UK-5 satellite. This high-sensitivity device with real-time coverage of the entire celestial sphere would aid in programming satellite maneuvers such that transient events in the x-ray sky could be investigated in detail by the other primary satellite experiments. Discussion of design criteria for the camera geometry, the position-sensitive proportional detector, and electronics to handle the data are presented. (4 figures) (auth)

43044 DESIGN OF THE SOLAR X-RAY INSTRUMENT FOR OSO-H. Harrington, T. M. (Analog Tech. Corp., Pasadena, Calif.); Maloy, J. O.; McKenzie, D. L.; Peterson, L. E. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 596-605(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The OSO-H Solar X-Ray instrument monitors x rays from the sun in the energy range 1 to 300 keV, as well as charged-particle background. The electronics provide accurate logarithmic pulse-height analysis at the high counting rates expected under flare conditions. A high-time-resolution mode enables study of the temporal development of a solar flare. (4 figures, 5 tables) (auth)

43045 GAMMA-RAY MONITOR FOR THE OSO-7 SPACECRAFT. Higbie, P. R.; Chupp, E. L.; Forrest, D. P.; Gleske, I. U. (Univ. of New Hampshire, Durham). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 606-12(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A 3″ × 3″ NaI((Tl) gamma-ray (0.3 to 10 MeV) spectrometer with a CsI (Na) charged-particle and anti-Compton shield was developed for the ORBITING SOLAR OBSERVATORY (OSO-7), which was launched September 30, 1971. The instrument, designed for a rotating-wheel compartment, utilizes a 377-channel quadratic PHA with accumulation times of 0.5, 1, or 3 minutes. Quick-look and calibration data obtained via a direct data link to a minicomputer at the UNH campus allow near-real-time monitoring and control of the experiment. Various commands changing the operating mode can be executed. The functions which can be commanded include rotation of the quadrants in which data is collected by 90°, gain adjustment of the central detector over a 6 : 1 range, manual or automatic sequencing of calibrations, variation of accumulation times by telemetering selected channels, and selection of reference directions. A small x-ray detector covering the range 7.5 to 120 keV is also included. (6 figures, 2 tables) (auth)

43046 DESIGN OF THE PARTICLES EXPERIMENT SUBSYSTEM OF THE APOLLO LUNAR SUBSATELLITE. Baum, J. J. (Analog Tech. Corp., Pasadena, Calif.); Harman, R. W.; Maronde, R. G.; Hornbuckle, T. A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 632-9(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The Particles Experiment Subsystem of the Apollo 15 Particles and Fields Subsatellite is now providing electron and proton energy spectra and flux information from lunar orbit. The experiment employs two silicon detector telescopes and a set of spherical plate electrostatic analyzers. Design of the overall instrument package is discussed, and some of the data obtained are presented. (6 figures, 3 tables) (auth)

43047 SCINTILLATION COUNTING COMPOSITION CONTAINING OXADIAZOLE. Maeder, Erwin; Anliker, Rudolf; Schmid, Karl; Siegrist, Adolf Emil. U. S. Patent 3,666,683. 30 May 1972. Filed 9 Jun 1969.

The invention relates to a composition of matter for counting atomic disintegrations of radioactive material which is accompanied by emission of β-rays which contains a substituted diphenyloxadiazole. The counts per minute emitted by the material dispersed in the scintillation liquid are measured with a suitable instrument such as a liquid scintillation spectrometer. (auth)

43048 APPARATUS FOR INDICATING THE POSITION OF A REFERENCE MARKER USED IN A GAMMA RAY CAMERA. McCready, Victor Ralph; Newbery, Sidney Patrick (to National Research Development Corp.). U. S. Patent 3,666,952. 30 May 1972. Priority date 30 Apr 1969, Great Britain.

Apparatus for indicating the position of a reference marker is adapted for use with a medical gamma camera. A movable reference marker is coupled to a fixed reference member by an arm. X and y coordinate voltages are generated and fed to a display screen of the gamma camera to produce a reference mark on the screen corresponding to the position of the marker. (3 figures) (auth)

43049 EFFICIENCY OF TRACK DETECTORS FOR FISSION FRAGMENTS. Koroleva, T. V.; Kraitor, S. N. This paper was summarized in At. Energ. (USSR); 31: No. 1, 52(Jul 1971) as paper No. 507/6039. (In Russian).

Full copy of this paper is held by TIC.

The efficiency for detecting fission fragments and neutrons with track detectors was calculated with the anisotropy of the fission process taken into account. The efficiency for detecting fragments is independent of the incident neutron energy for mica, whereas the anisotropy of the fission process in the range 0.5 to 10 MeV increases the efficiency by 10 to 20% relative to an isotropic angular distribution in the case of silicate glass; the isotropic distribution is encountered in fission processes involving thermal neutrons. For quartz glass the increase in efficiency was 4 to 7%. The efficiency for detecting neutrons was calculated; the curve reproduces the dependence of the fission cross section on the neutron energy for mica, but not for silicate and quartz glasses. The ratio of the efficiency for ^{235}U fragment detection with a silicate glass detector to the efficiency for detection of thermal neutrons was measured; the calculated results agreed with this value. (2 figures) (R.W.R.)

43050 GEOMETRICAL CORRECTIONS IN COINCIDENCE MEASUREMENT OF NUCLEAR REACTIONS USING GAS TARGET. Kondo, K.; Sanada, J. (Tokyo Univ. of Education). Nucl. Instrum. Methods; 102: No. 2, 189-92(1972).

Purely geometrical corrections inherent in the measurement of the double cross section $d^2\sigma/d\Omega_1 d\Omega_2$ using a gas target, where two particles in the final state are detected in coincidence, are presented. Numerical examples of cases actually used in measurements of proton—proton bremsstrahlung are given. (auth)

43051 FAST-NEUTRON FLUX MEASUREMENT WITH LITHIUM-DRIFTED GERMANIUM DETECTOR. Smith, D. L. (Argonne National Lab., Ill.). Nucl. Instrum. Methods; 102: No. 2, 193-9(1972).

The use of lithium-drifted germanium detectors for fast-neutron flux measurement has been investigated. The proposed detection mechanism is observation of the internal conversion electrons emitted during the de-excitation of the 691 keV 0^+ state in ^{72}Ge following excitation via fast-neutron scattering. A 4.0 cm^3 (approx.) planar Ge(Li) detector has been calibrated for neutron flux measurements over the energy range E_n = 700 to 5000 keV. The absolute efficiency for this detector (ratio of neutrons detected to neutrons incident on the detector) has been determined to be $(8.2 \pm 0.5) \times 10^{-4}$ at E_n = 1500 keV which is about 10% of the full-energy peak efficiency for 1332 keV ^{60}Co gamma rays. Cross-sections for excitation of the 691 keV 0^+ state in ^{72}Ge via neutron scattering have been extracted from the measured efficiency function. These cross-sections can be used to calculate efficiency functions for other detectors. Insensitivity to thermal neutrons, gamma-ray discrimination capability, and stability are among the desirable features of this type of fast-neutron detector. Submicrosecond timing is not possible because of the isomeric nature of the 691 keV 0^+ state in ^{72}Ge. While Ge(Li) detectors suffer radiation damage from fast-neutron bombardment, the detector used for these measurements withstood an integrated dose exceeding 10^{10} neutrons/cm^2 without serious deterioration of its performance. (auth)

43052 PARTICLE IDENTIFICATION FOR A POSITION SENSITIVE PROPORTIONAL COUNTER. Williams, M. E. (Rutgers—The State Univ., New Brunswick, N. J.); Kruse, T.; Bayer, D.; Williams, N.; Savin, W. Nucl. Instrum. Methods; 102: No. 2, 201-4 (1972).

A three-counter telescope (a position-sensitive proportional counter, an energy loss proportional counter, and a residual energy plastic scintillator) of about 25 cm active length provides energy and rate of energy loss information for identification of particle type. One counter provides position information after magnetic analysis. Two-dimensional display and curved digital windows select particles of various types. (auth)

43053 DETAILED DESCRIPTION OF A SIMPLIFIED RADIO-LIQUID CHROMATOGRAPH. Tomono, K.; Tokunaga, N.; Koyano, A.; Toyohara, M.; Shigematsu, A. (Research Inst. of Tuberculosis, Tokyo). Nucl. Instrum. Methods; 102: No. 2, 257-67(1972).

The details of a simplified radio-liquid chromatographic system for simultaneous recording of light absorbance and radioactivity of the eluate from liquid or gas chromatographic columns are described. The counting efficiency of the radiation detection system was dependent upon the relative flow-rates of the eluate and the scintillation mixture. A high counting efficiency was obtained with naphthalene in a dioxane type scintillation fluid. No change in efficiency was noted when nebulization and cavitation for more complete emulsification were omitted from the system. Overall counting efficiencies for the systems were 45.5% for tritiated materials and 82.7% for ^{14}C labeled materials. An interval of about 30 s was required to obtain resolution between different patterns of radioactivity. The minimum volume of radioactive material needed for monitoring was 0.01 ml of 0.06 μCi per ml for tritiated materials. By simultaneous recording of light absorbance and radioactivity of different pyrimidine ribosides, ^{14}C-cytidine and ^{3}H-uridine, good discrimination of beta energies were obtained and the counting efficiency was similar to that of a liquid scintillation counter. (auth)

43054 RISE TIME GATED LEADING EDGE TRIGGER FOR IMPROVED TIMING OF MONOENERGETIC GAMMA RAYS WITH Ge DETECTORS. Cho, Z. H.; Chase, R. L. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods; 102: No. 2, 299-304 (1972).

With monoenergetic gamma rays on planar Ge(Li) detectors, it is possible to achieve timing accuracy very close to the theoretical limit despite the low initial slope of the charge signals and the increasing probability of slope change as bias levels are increased. A rise-time gating circuit permits biasing a leading-edge trigger above the initial "toe" by rejecting those signals that experience a slope change below the bias level. Line widths of 770 ps fwhm and 1.5 ns fw $^1/_{10}$m have been achieved with 511 keV gamma rays using a 10 pF planar germanium detector and a plastic scintillation counter. (auth)

43055 VERSATILE ANTICOINCIDENCE GATE. Church, V. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 102: No. 2, 305-7(1972).

This gate uses a sequential logic technique to avoid delaying or differentiating the signal or inhibiting pulses. It is useful for single channel analyzers because of its insensitivity to delays between the signal and inhibiting pulses. (auth)

43056 GAS AMPLIFICATION FACTOR IN XENON FILLED PROPORTIONAL COUNTERS. Hendricks, R. W. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 102: No. 2, 309-12(1972).

The gas amplification factor in a variety of commercial xenon filled proportional counters has been found to obey equally well both the Diethorn equation and the Zastawny equation over the range of variables studied. Constants appropriate to each equation have been determined for both Xe—5% CO_2 and Xe—10% CH_4 fill gases. (auth)

43057 KINEMATIC SEPARATIONS FOR THREE BODY FINAL STATE REACTIONS. Thompson, D. T.; Tripard, G. E. (Washington State Univ., Pullman). Nucl. Instrum. Methods; 102: No. 2, 327-31(1972).

Three body final state reactions at low energy in which two nonidentical charged particles are detected are complicated by kinematic interference in certain regions of the kinematic plane. Preliminary results are presented which indicate that a time-of-flight technique can be used to separate interfering kinematic events without the loss of any experimental information. (auth)

43058 INEXPENSIVE LARGE AREA COUNTERS USING MULTI-WIRE PROPORTIONAL CHAMBERS. Lanza, R.; Hopkins, N. (Massachusetts Inst. of Tech., Cambridge). Nucl. Instrum. Methods; 102: No. 2, 333-6(1972).

Multi-wire proportional chambers are used as a replacement for conventional large area plastic scintillators. For applications which can tolerate larger time jitters than are obtained from scintillators, the proportional chamber is less expensive and more flexible, particularly in magnetic fields. A technique is described which permits inexpensive mechanical construction by means of lamination of frames from thin sheets. This method of frame construction should be useful for spark chamber frames as well as proportional chambers because it provides rigid, flat frames with no machining. (auth)

43059 IMPROVED RESOLUTION FOR LOW ENERGIES WITH GAS PROPORTIONAL SCINTILLATION COUNTERS. Policarpo, A. J. P. L.; Alves, M. A. F.; Dos Santos, M. C. M.; Carvalho, M. J. T. (Univ., Coimbra). Nucl. Instrum. Methods; 102: No. 2, 337-48(1972).

Observation of the light emitted by xenon, when the primary electrons produced by an ionizing particle are accelerated under an electric field, allows the detection of energies, in the ionization chamber region, that, with gas counters, were only previously detectable in the proportional region. For example, for 5.9 keV a full width half maximum of 500 eV was measured. The relative variance of the pulses from the gas proportional scintillation counter is $0.087\ E^{-1/2}$ (E in keV) and can be slightly improved. The possibility of using the counter for fast coincidence work is considered. (auth)

43060 NEUTRON PRODUCED CARBON RECOIL SCINTILLATIONS IN NATON 136 PLASTIC SCINTILLATOR. Burke,

C. A.; Lefevre, H. W. (Univ. of Oregon, Eugene). Nucl. Instrum. Methods; 102: No. 2, 357-9(1972).

Carbon recoil events were identified by resonant scattering of 2.1 MeV neutrons from carbon atoms in a Naton 136 plastic scintillator. Scintillations were detected with an RCA C70133B photomultiplier tube biased to accept pulses larger than those produced by 50 keV recoil protons. A pulsed 4 MeV proton beam onto a thick lithium metal target provided zero degree neutrons of energies up to 2.3 MeV. Dual parameter pulse height versus time-of-flight spectra were collected. Results show that carbon recoils account for 30% of the events detected for neutron energies near 2 MeV. The maximum pulse height due to carbon recoil scintillations (0.59 MeV recoil carbon energy) is about 2% of that from 2.1 MeV recoil protons. The specific light output of carbon recoils relative to electrons in Naton 136 is about 50% greater than that measured for NE 102 plastic scintillator by Steuer et al. and that inferred from other measurements by Batchelor et al. (auth)

43061 ORIGIN OF THE BACKGROUND COUNTING RATE OF CURVED CHANNEL MULTIPLIERS. Andresen, R. D.; Page, D. E. (European Space Research and Tech. Centre, Noordwijk, Netherlands). Nucl. Instrum. Methods; 102: No. 2, 363-4(1972).

An experiment has been carried out demonstrating that more than 95% of the background signals of curved channel multipliers are initiated inside the device. The side detection efficiency of this detector for the hard component of sea level cosmic rays has been determined to be 3.3%. (auth)

43062 NOTE ON THE DETECTION OF HEAVY IONS BY OVER-BIASED TOTALLY DEPLETED THIN SURFACE BARRIER DETECTORS. England, J. B. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 102: No. 2, 365-6(1972).

The possibility of achieving good charge collection for heavy ions in thin, high resistivity, surface barrier silicon detectors under large over-bias conditions is briefly discussed and some experimental results presented. (auth)

Radiation Dosimeters

Refer also to abstracts 43383, 44991, and 44992.

43063 (BARC—594) FEASIBILITY STUDIES OF USING BARE LiF SINGLE CRYSTALS FOR IN-VIVO RADIATION DOSIMETRY. Hukkoo, R. K.; Sachdev, M. R.; Wadhwani, C. N.; Somasundaram, S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 31p. Dep. NTIS (U. S. Sales Only).

Accurate in-vivo radiation dosimetry requires direct implanting of dosimeters at the site of interest in living tissue or inanimate phantoms. Dosimetric grade LiF is reported to be toxic and soluble, which results in the release of stored energy. Due to etching of the surface, the transparency of the dosimeter to its own thermally-stimulated radiation changes, thus requiring a fresh set of calibration curves which should be obtained only after the retrieval of the dosimeter. A procedure has been described to overcome some of these difficulties by giving a protective film of SnO_2 to bare LiF single crystals. The stability of the film has been studied by subjecting the dosimeters to numerous standard annealing-irradiation and readout cycles. The film was found insoluble in solutions of different pH comparable to body fluids. Preliminary data show that the treated dosimeters are very well accepted by living tissue. The various characteristics of coated and uncoated dosimeters are compared. (auth)

43064 (DREO-TN—72-12) RELATIONSHIPS BETWEEN DOSIMETER RESPONSE AND ABSORBED DOSE FOR 0.66-MeV GAMMA RAYS AND FOR 2.95-MeV NEUTRONS. Clifford, C. E.; Facey, R. A. (Defence Research Establishment, Ottawa (Ontario)). Mar 1972. 11p. (PD—14264). Dep. NTIS (U. S. Sales Only).

The dose at sites in the interior and on the surface of a human phantom was measured for broad-beam exposure to 0.66-MeV gamma rays and to 2.95-MeV neutrons. Measurements were made for a range of angles of radiation incidence. A comparison is presented between the surface dose at possible dosimeter locations on the chest, abdomen and groin and the corresponding absorbed dose to the bone-marrow system and to the abdomen. Unless the geometry of exposure is accurately known, it is shown that a chest dosimeter is a poor indicator of the absorbed dose. A dosimeter worn on the groin would be significantly better for both neutrons and gamma rays for a wide range of exposure geometries. (auth)

43065 ELECTROCHEMICAL METHOD OF DETERMINING THE RADIATION DOSE RATE. Gochaliev, G. Z.; Borisova, S. I. This paper was summarized in At. Energ. (USSR); 31: No. 2, 138-9(Aug 1971) as paper No. 518/5891. (In Russian). Full copy of this paper is held by TIC.

A new type of electrochemical dosimeter is proposed for the determination of the radiation dose rate according to the currents of electrochemical oxidation or reduction of radiolysis products (RP). In comparison with known samples, these detectors possess the following advantages: a larger range of measurements of the dose rate, smaller range with hardness, and possibility of use with any type of radiation. The operating principle consists of the fact that in continuous electrochemical oxidation or reduction of RP in a limited volume of solution, some time after the beginning of irradiation, a stationary distribution of the concentration is established, and, consequently, a stationary distribution of the ionization currents of the RP. The stationary currents increase as a linear function of the rate of formation of RP or the dose rate. Detectors suitable for the determination of the dose rate of soft radiation take the form of cuvettes opened from above, filled with the working solution. The indicator electrode is fastened to the bottom of the cuvette and has an opening opposite the tube soldered to the borrom of the cuvette, communicating with the auxiliary electrode. Detectors in which the working volume of the solution is included in a capillary electrode of platinum were investigated in detail. The diameter of the electrode was 2.2 mm and the wall thickness 20 μ. The working volume was equal to 0.11 cm^3, and when necessary it could be reduced severalfold. The electrode was welded to the inner surface of a glass tube, sealed from below. At the other end of the electrode the tube has a partition separating the working volume from the auxiliary electrode. A mercury sulfate electrode served as the reference electrode and simultaneously as the auxiliary electrode. The stationary distribution of the concentration and the stationary currents are described by equations. Results are presented. (W.H.K.)

43066 THERMOLUMINESCENT PROPERTIES OF CaF_2:Dy TLD'S. Sukis, Daniel R. (Raytheon Co., Sudbury, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 185-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Selected thermoluminescent (TL) properties of CaF_2Dy TLD's have been investigated for a single batch of crystals. These include phosphor response, glow curve structure, long term signal fading, and pre-irradiation annealing effects. ^{60}Co exposures ranged from 0.1 to 3×10^3 roentgens (R). Comparisons are made with data presently available in the literature and notable discrepancies are identified. These discrepancies are used to demonstrate the necessity of characterizing the TL properties of each batch of CaF_2: Dy crystals prior to use as a radiation detector. Techniques developed during the investigation for improving the accuracy of dosimetry data obtained with the phosphor are discussed. (auth)

43067 DEPTH DOSE CALORIMETER FOR HIGH INTENSITY, LOW VOLTAGE FLASH X-RAY MACHINES. Wood, D. S. (Physics International Co., San Leandro, Calif.). Rev. Sci. Instrum.; 43: No. 8, 1094-6(Aug 1972).

A small tantalum foil depth dose calorimeter has been constructed for use with high intensity flash x-ray sources. Incident x-ray energy is deposited in an array of tantalum foils monitored by 25 μ iron—Constantan thermocouples. Readout is made with a high speed scanning digital microvoltmeter. Comparison is made between the measured x-ray energy deposition in tantalum and the deposition calculated with a Monte Carlo computer code which takes account of the current and voltage waveforms on the diode. (auth)

43068 SMALL COMBINATION X-RAY CALORIMETERS. Pellinen, D. G. (Physics International Co., San Leandro, Calif.). Rev. Sci. Instrum.; 43: No. 8, 1181-4(Aug 1972).

An array of x-ray calorimeters reading absolute energy fluence and front surface dose in tantalum was developed for measuring the areal distribution of x rays from a pulsed source. The device functions in a high electrical noise environment and in pulsed magnetic fields in excess of 1 T. The fluence detector utilizes a shielded construction to allow accurate measurements to be made in inhomogeneous radiation fields. (auth)

43069 APPLICATIONS OF TRACK ETCHING IN NEUTRON DOSIMETRY. Becker, Klaus (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 116(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43070 TRACK ETCH REGISTRANTS FOR HIGH-TEMPERATURE APPLICATIONS. Kosanke, H. D. (General Electric Co., Pleasanton, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 124-5 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43071 BETA DOSES IN WET TISSUE. Walinder, G. (Foersvarets Forskningsanstalt, Stockholm). FOA (Forsvarets Forsk.) Rep.; 6: No. 7, 1-2(Apr 1972).

The concept of tissue equivalence and the possibility of determining the beta-dose rate in vivo by in vitro measurements are studied. It is shown that the material parameters which determine the absorption and scattering of beta particles from radionuclides can be deduced from fairly elementary calculations by application of the "Born approximation". A film-dosimetric technique based on these deductions is described. Finally, the results of the present work and those of other authors as regards the necrotizing dose from ^{90}Y applicators implanted in human pituitaries are discussed with reference to the material parameters. (auth) (Sweden)

43072 DOSIMETRY OF NARROW PROTON BEAMS. Vanin, V. I.; Vinogradov, B. V.; Voronin, Yu. V.; Karlin, D. L. Med. Radiol.; 17: No. 3, 71-5(Mar 1972). (In Russian).

The detector dimensions are important to the accurate dosimetry of narrow proton beams. A method and apparatus are described for determining the dose distribution in two kinds of beams on the basis of a plane-parallel ionization chamber with divided collecting electrodes. Results are given for the measurement of narrow proton beams of 600 to 800 MeV energy. (tr-auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 44627.

43073 (SGAE – 2013) MEASUREMENT AND EVALUATION OF γ SPECTRA WITH A SMALL CALCULATOR. Wessner, E. F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). Apr 1972. 68p. (In German). (PH – 117/72). Dep. NTIS (U.S. Sales Only).

The use of a computer instead of a multichannel analyzer for spectrum analysis is discussed, and the present state of spectrum analysis is reviewed. (W.H.K.)

43074 AUTOMATIC CONSTANT-VELOCITY MOESSBAUER SPECTROMETER. Reiman, S.; Realo, E. (Inst. of Physics and Astronomy, Tallin, USSR). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 21: No. 1, 41-6(1972). (In Russian).

An automatic constant–velocity spectrometer for Moessbauer investigations is described. The Doppler region of ±10 mm/s can be divided into 200 or 400 channels. The detailed description and the operation principles of the feedback-controlled electromechanical transducer, the nonsymmetrical rectangular reference voltage generator, the automatic operation system, and an electronic gate are given. As a radiation detector, a scintillation counter with a linear amplifier and a differential discriminator is used. The pulses corresponding to Moessbauer γ-quanta at certain energy (velocity) are collected during the time interval of 10 to $8 \cdot 10^3$s predetermined by a quartz-controlled timer of the scaler ПП-15. The Moessbauer spectra are automatically plotted point-by-point by means of a XY-recorder, the Y-input of which is coupled to the scaler via a 3-decade digit-to-analog converter. The X-input (velocity axis) of the recorder is connected to the reference voltage generator. The "dead" time of the spectrometer is less than 30 percent. A better stability of the velocity than ±0.03 mm/s can be achieved. A typical velocity calibration spectrum of Fe_2O_3 is presented. (auth)

43075 IN-BEAM MOESSBAUER SPECTROSCOPY IN SCATTERING GEOMETRY. Hicks, J. A.; Owens, W. R.; Wilenzick, R. M. (Tulane Univ., New Orleans). Rev. Sci. Instrum.; 43: No. 8, 1086-7(Aug 1972).

An in-beam spectrometer system has been modified to allow Coulomb excitation Moessbauer measurements in a back scattering geometry, rather than the usual transmission arrangement. Moessbauer scattering measurements with the 122.6 keV γ rays of ^{186}W are presented and compared with the results of conventional techniques. (auth)

43076 ANTICOINCIDENCE-SHIELDED MULTIPLE COINCIDENCE GAMMA-RAY SCINTILLATION SPECTROMETER. Brauer, F. P.; Connally, R. E.; Rieck, H. G. Jr. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 153-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43077 NEUTRON SPECTROMETRY USING ORGANIC SEMICONDUCTORS. McGuire, Stephen A. (Instituto Militar de Engenahria-Ureca, Rio de Janeiro); Vogelsang, William F. Trans. Amer. Nucl. Soc.; 15: No. 1, 158-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43078 USE OF ^{252}Cf IN CALIBRATING A GAS SCINTILLATION SPECTROMETER. Pagano, Roberto; Wethington, John A. Jr. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 15: No. 1, 173-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43079 FOURIER TRANSFORM FILTERING OF PROTON-RECOIL DATA. Woodruff, Gene L.; Sloan, W. Robert (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 15: No. 1, 469-71(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43080 METHOD FOR UNFOLDING BOUNDED RADIATION DATA. Kirmser, Philip G.; Hu, Kuo-kuang; Meyer, Walter (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc.; 15: No. 1, 541-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43081 COMPUTER SIMULATION OF AN AIR-BORNE GAMMA-RAY SPECTROMETER. Clark, Ronald B.; Duval, Joe S. Jr.; Adams, John A. S. (Rice Univ., Houston, Tex.). J. Geophys. Res.; 77: No. 17, 3021-31(10 Jun 1972).

A computer model is presented that simulates the data from a flight of an air-borne gamma-ray spectrometer over a surface containing gamma-ray sources of arbitrary horizontal dimension and coordinates. The mathematical formalism is given, together with a discussion of the assumptions or approximations that are made. Representative computational results are shown for simulated flights over circular sources and across linear sources. (auth)

43082 FUTURE OF SOLID-STATE DETECTORS IN CANCER RESEARCH. Hoffer, Paul B.; Gustaitis, John; Beck, Robert N. (Univ. of Chicago. Argonne Cancer Research Hospital, Chicago). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 51-4(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The future will see increased use of semiconductor detectors in both the clinical and research aspects of nuclear medicine, particularly in cancer detection and control. The excellent energy resolution of the Si(Li) detector allows the use of x-ray fluorescence in vivo to image body organs; dose to both gonads and total body is low with this technique. The compact size and good energy resolution of semiconductor spectrometers will enable the use of radioisotopes previously rejected on physical characteristics. Solid-state detectors also promise to allow strides in the evaluation of new tumor-localizing agents. (5 figures, 2 tables) (R.W.R.)

43083 ANTICOINCIDENCE SHIELDED NaI(T1) SYSTEM AT NBS. Hutchinson, J. M. R.; Lantz, J. L.; Mann, W. B.; Mullen, P. A.; Rodriguez-Pasques, R. H. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 117-18(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The design and operation of an anti-Compton anticoincidence NaI(Tl) $4\pi\gamma$ detector system at the National Bureau of Standards are described. The system consists of two 8 × 4-in. NaI(Tl) well crystals mounted face to face surrounded by a 30-in. diameter by 20-in. long NE 110 plastic scintillator. The system was designed for the purpose of measuring total activity. The count rate of this system is relatively insensitive to source position. (5 figures, 1 table) (R.W.R.)

43084 DIRECT EVALUATION OF LOW-LEVEL COUNTING TECHNIQUES EMPLOYING Ge(Li) DETECTORS. Walford, G. V. (Nuclear Enterprises Ltd., Edinburgh); Aliaga-Kelly, D. T. W.; Gilboy, W. B. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 127-34(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The low-level counting capabilities and critical parameters of Ge(Li) gamma-ray spectrometers are investigated using an expression for the spectrometer sensitivity limit. The significance of the counting parameters involved and the practical means by which they may be optimized are also considered. A comparison method is used to evaluate the effectiveness and behavior of several available counting techniques (e.g., coincidence and anti-coincidence methods). (4 figures, 3 tables) (auth)

43085 INVESTIGATION ON THE BACKGROUND OF A Ge(Li) DETECTOR. Bertolini, G. (Joint Nuclear Research Center, Ispra, Italy); Cappellani, F.; Restelli, G.; (and others). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 135-40(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

An experimental study was performed to investigate the ultimate limit of the intrinsic background of a Ge(Li) detector. The results obtained in three runs under different experimental conditions are compared and discussed. A tentative interpretation of the various sources of background and of their relative contribution is given. From the measurements performed in an underground laboratory with an attenuation factor for cosmic rays of 10^6, the ultimate background level appears almost completely due to radioactivity present in the structural materials of the cryostat and shield. An important contribution is attributable to airborne radioactivity due to ^{222}Rn daughters. (2 figures, 3 tables) (auth)

43086 HASL Ge(Li)–NaI(Tl) LOW–LEVEL COUNTING SYSTEM. Latner, Norman; Sanderson, Colin G. (Atomic Energy Commision, New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 141-50(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A high-efficiency Ge(Li) detector system with a NaI(Tl) annulus and "back-detector" was developed to provide coincident and anticoincident gamma-ray spectrometry of low-level samples. Independent control of the three detector signals and a flexible logic arrangement allow optimum detection of noncoincident (Compton suppression) or coincident gamma rays with either wide or narrow angles of correlation. This counting system and its application to the analysis of environmental samples are described. (11 figures, 2 tables) (auth)

43087 McCLELLAN CENTRAL LABORATORY'S ANTICOINCIDENCE Ge(Li) SPECTROMETERS FOR LOW LEVEL APPLICATIONS. Ohlwiler, Robert W. (Air Force Technical Applications Center, McClellan AFB, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 166-7(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A low-background Compton-suppression Ge(Li) system is described. It consists of a Ge(Li) diode surrounded by an NELLO plastic scintillator annulus. The peak-to-Compton ratio of the 662-keV ^{137}Cs line is 32 in the normal mode and about 175 in the anticoincidence mode. A block diagram of the Ge(Li) Compton suppression system is given. (4 figures, 2 tables) (R.W.R.)

43088 SEMICONDUCTOR-DETECTOR OPTIMIZATION FOR TRACE MERCURY ANALYSIS IN ENVIRONMENTAL SAMPLES. Walker, D. M.; McLain, M. E.Jr.; Leddicotte, G. W. (Georgia Inst. of Tech., Atlanta). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 184-90(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The counting of low-energy gamma rays from mercury in activated environmental and biological samples is often hindered by dominant activity of higher-energy gamma rays from elements such as sodium. An investigation of gamma-ray interaction theory for silicon and germanium at these energies shows that germanium is the preferred material, and that a detector thickness of about 5 mm in the direction of the incident gamma ray is optimum for mercury counting. Measurements and figure-of-merit calculations for true coaxial, closed-end coaxial, and thin high-resolution planar Ge(Li) detectors resulted in FOM values for this application of 2.5 to 4.6 for the large-volume coaxial detectors and 8.0 to 17.3 for the thin planar detectors. Coincidence counting of the gamma and x rays can yield large FOM values and separation of the gamma and x rays in the recorded spectrum. Certain phenomena related to coincident emission, to background efficiency, and to energy resolution are not included in the FOM, and should be considered separately in defining optimum detectors. (3 figures, 2 tables) (auth)

43089 BRIEF REVIEW OF RECENT ADVANCES IN COMPOUND SEMICONDUCTORS FOR RADIATION DETECTORS. Miller, G. L. (Bell Telephone Labs., Murray Hill, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 251-9(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The basic requirements for a semiconductor to be useful as a radiation detector are briefly summarized: these include long trapping length, wide band gap, high Z, and low net impurity concentration. Methods for evaluating semiconductor detector materials are discussed in six basic categories: mass spectrographic and chemical analysis, optical, electrical, electro-optical, channeling, and detector measurements. The final performance of a radiation detector depends on two major activities, crystal growth and suitable contacting procedures. Actual detector results so far demonstrated for CdTe, GaAs, and HgI$_2$ are discussed. It is felt that future prospects for GaAs, in particular, look bright. (13 figures, 4 tables) (R.W.R.)

43090 BEHAVIOR OF γ-RAY DETECTORS FROM HIGH-PURITY GERMANIUM AT LOW TEMPERATURE. Stuck, R.; Ponpon, J. P.; Siffert, P. (Centre de Recherches Nucleaires, Strasbourg). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 270-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

γ-ray spectrometers prepared from high-purity germanium were studied at low temperature down to 5°K. If sufficient bias voltage was applied, the same energy resolution at 5°K as at 77°K was found. At lower bias voltage, below 10°K, the resolution deteriorated rapidly due to the appearance of a slowly rising component (up to several microseconds) in the pulses. This behavior seems to be related to the effect on the signal of the resistance and capacitance of the undepleted region—the resistivity becoming significant at low temperature due to carrier freeze-out on the primary shallow donors—rather than to the effect of carrier trapping by shallow level impurities. (12 figures, 1 table) (auth)

43091 DRAIN FEEDBACK: A NOVEL FEEDBACK TECHNIQUE FOR LOW-NOISE CRYOGENIC PREAMPLIFIERS. Elad, E. (ORTEC, Inc., Oak Ridge, Tenn.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 403-11(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

This paper describes a novel technique of charge restoration—the drain feedback, based on the characteristics of the gate-to-drain junction of the input FET. The restoration charge required at the input of the preamplifier is generated by impact ionization in high-field regions of the FET. Actually, the feedback is obtained by regulating the drain voltage according to the input energy–count-rate product and, consequently, adjusting the electric field for the necessary charge generation. The principles of impact ionization in semiconductors at cryogenic temperatures are outlined and applied to junction FET's under saturation conditions. Then, the properties of FET gate leakage current generated by impact ionization are analyzed. Finally, the continuous mode of operation of the new feedback method is presented, and results from its application in x-ray spectroscopy with silicon and germanium detectors are given. Superior noise and count-rate performance coupled with simplicity and reliability are the outstanding features of the drain feedback method. It is the first feedback method in which the cryogenic input stage comprises the detector and the FET without the parasitic increases of stray capacitance or light-induced leakage currents characteristic of the other resistorless configurations. (13 figures) (auth)

43092 TRAPEZOIDAL FILTERING OF SIGNALS FROM LARGE GERMANIUM DETECTORS AT HIGH RATES. Radeka, V. (Brookhaven National Lab., Upton, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 412-28 (Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A filter with a trapezoidal weighting function is the optimum one when both noise and variations in the charge collection time are present. A trapezoidal filter was realized by a time-variant (gated filter) system. The results obtained with large germanium detectors at high rates and higher energies are presented; it is found that trapezoidal filtering is essential for good resolution in this case. (15 figures, 1 table) (auth)

43093 PULSE-SHAPE ANALYZER FOR PHOSWICH DETECTORS. Shoffner, Bruce M. (Harshaw Chemical Co., Solon, Ohio). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 502-11(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

An electronic technique for separating the signals from a phoswich detector is discussed. The preamp output signal is amplified by two double-delay-line amplifiers operating in parallel. The time difference between the crossover points of the two amplifier output signals is measured. This time difference is a function of the detector pulse shape. For small pulses, this technique has less time jitter than the more usual leading edge/crossover measurement. It is also less sensitive to control misadjustments. An instrument based on this principle is described. (9 figures) (auth)

43094 EFFECT OF SURFACE CONTAMINATION ON THE PERFORMANCE OF A SURFACE-BARRIER DETECTOR FOR USE IN SPACE ENVIRONMENT. Bawdekar, Vaman S.; Sos, Alexander J. (American Science and Engineering, Inc., Cambridge, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 618-25(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Alpha-particle resolution of a surface barrier detector/preamplifier combination is adversely affected by excessive noise of the detector. The detector noise increases when the substrate is exposed at the site of contamination introduced into the coated wafer surfaces during the manufacture of the detector. Mechanisms by which substrate exposure may occur are presented. Increase in detector noise by substrate exposure is shown to follow the basic photoconductivity equation. Noise performance of a detector with surface contamination is observed to have three modes of degradation, depending upon the nature of contamination. Of the three modes, the one caused by an outgassing/insulating type of contamination is sporadic in nature and is difficult to identify. Long-term vacuum cycling tests are evolved to identify this mode of degradation. (8 figures, 2 tables) (auth)

43095 MAGNETIC TAPE DATA INTERFACE FOR MULTIPLE Ge(Li) SPECTROMETERS. Austin, Roland R. TRAPELO/WEST, Richmond, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 668-73(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A buffered electronic data transfer interface was developed for acquiring data from 1 to 14 Ge(Li) and/or NaI(Tl) gamma spectrometers and processing this data in an IBM 1130 Minicomputer System. Sample instrument and spectrum data are transferred between remote spectrometers and mass storage buffer and between buffer and processor as standard formatted data files. Spectrometers and the processor are serviced on a time-sharing basis in accordance with a multiple service demand queue. The first record of each magnetic tape data file consists of a serial file number and all samples and instrument data. Sample and instrument data, including sample number, sample group code, accumulate time, configuration code, energy range code, energy calibration code, instrument number and analysis code, are entered from punched sample cards, thumbwheel switches and a time of year clock. All subsequent data file records consist of spectra data. Operation of the data interface is initiated from individual spectrometers, the data interface Control and Data Unit, or from the processor. Part of the data interface was installed and placed in continuous operation with one Ge(Li) spectrometer in 1970. Additional spectrometers and interface equipment are currently being added to complete the system. (6 figures) (auth)

43096 VERSATILE GAMMA SCANNING SYSTEM. Swinth, K. L. (Battelle-Northwest, Richland, Wash.); Weber, J. W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 820-7(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A versatile gamma scanning system was designed and installed for the scanning of irradiated fuels. The system traverses a fuel pin past an area-defining slit in a reproducible and accurate manner. Activity from the examined area is detected by a high-resolution solid-state detector. Signals from the detector are amplified and routed to single-channel analyzers or to a multichannel analyzer. The use of a four-input multichannel scalar permits storage of four specific energy groups versus position. A scan control module controls the operation of a stepping motor, which moves the fuel pin axially past the collimator. Limit switches are used to define the scanned area. The control module also advances the multichannel scalar at selected intervals and determines the rate and direction of scanning. The use of a four-input multichannel scalar allows storage of data in four energy intervals from 512 consecutive points on the scanned element. For a typical pin this means that information is stored from 500 consecutive 27.5-mil increments. The unit is designed to scan fuel lengths of up to 50.2 in. in rods up to 84 in. long and from 0.2 to 1.125 in. in diameter. The information collected can be used to determine the distribution of activity in the fuel rod and to infer the relative distribution of specific isotopes. This information can be used to measure fuel burnup, fuel dimensions, and power distribution. Other quantities of interest may be inferred from the information obtained. (9 figures, 1 table) (auth)

43097 DUAL Ge(Li)–DUAL NaI(Tl) GAMMA-RAY SPECTROMETER. Brauer, F. P.; Kaye, J. H.; Fager, J. E.; Mitzlaff, W. A.; Rieck, H. G. Jr. (Battelle-Northwest Labs., Richland, Wash.). Nucl. Instrum. Methods; 102: No. 2, 223-35(1972).

A gamma-ray spectrometer consisting of a pair of high-efficiency Ge(Li) detectors mounted inside a large, split annulus of NaI(Tl) has been assembled. A 16k, 18 bit digital computer has been interfaced for data acquisition. Various coincidence and anticoincidence data accumulation modes have been evaluated for use in radiochemical analysis. (auth)

43098 REPRODUCTION OF MONOENERGETIC ELECTRON LINES IN A 4π-Si(Li)-β-SPECTROMETER USING A COINCIDENCE METHOD. Flothmann, D.; Gils, H. J.; Loehken, R.; Wiesner, W. (Univ., Heidelberg). Nucl. Instrum. Methods; 102: No. 2, 237-44(1972).

The K-conversion lines of ^{113m}In and ^{137m}Ba are measured with a Si(Li)-β-spectrometer operating in 4π-geometry. The characteristic K x-rays accompanying the conversion electrons are detected by a supplementary Si(Li)-detector providing a coincidence condition. The measured electron lines are asymmetric showing a tail on the low-energy side of the peaks. Including this tail into the peak area the measured peak-to-total ratios are (98.2 ± 0.9)% for ^{113m}In and (98.9 ± 0.8)% for ^{137m}Ba. These results clearly point out that the backscattering continuum is almost completely reduced to zero by the 4π-summing method. Possible explanations for the line tail, especially absorption and bremsstrahlung, are discussed. (auth)

43099 ANALYSIS AND INTERPRETATION OF GAMMA AND ALPHA SPECTRA WITH A SMALL REAL-TIME COMPUTER. De Regge, P. (SCK-CEN, Mol, Belgium). Nucl. Instrum. Methods; 102: No. 2, 269-80(1972).

The vast amount of information collected by modern semiconductor detectors has led to a widespread use of computers in interpreting and evaluating the spectra. The interpretation of complex alpha and gamma ray spectra using a small PDP8/I computer is described. The program includes a subroutine to smooth the accumulated data by convolution techniques. The detection of significant photopeaks in Ge(Li) spectra and the calculation of their boundaries, area, and energy are described. An empirical function fitting the count rate distribution of surface barrier detector alpha spectra is proposed. The results obtained by a spectrum stripping routine using this function are presented. (auth)

43100 DESIGN OF AN ELECTROSTATIC ELECTRON SPECTROMETER. Denk, W.; von Egidy, T. (Technical Univ., Munich). Nucl. Instrum. Methods; 102: No. 2, 281-4(1972).

An electrostatic electron spectrometer for energies between 1 and 50 keV has been designed. The instrument uses two plane retarding fields and two electrostatic lenses. The lenses have been optimized with a computer program. The calculated energy resolution is 0.2% for a source area of 6 cm^2 and a transmission of 5%. (auth)

43101 LINEAR AMPLIFIER FOR HIGH RESOLUTION NUCLEAR PULSE ANALYSIS. Karlsson, L. (Royal Veterinary and Agricultural Univ., Copenhagen). Nucl. Instrum. Methods; 102: No. 2, 285-97(1972).

Investigations on a high performance linear amplifier for use in nuclear spectroscopy are presented. The amplifier is characterized by a large gain range, a high gain stability, and a wide range of shaping time constants in order to suit different detector systems. A prompt and a delayed pulse are simultaneously available at two independent outputs. The application of temperature stabilized transistor pairs as input active elements results in a highly stable output dc level. The most important circuit features of linear amplifiers are discussed. (46 references). (auth)

43102 IMPROVED METHOD FOR LIVETIME CORRECTION IN PULSE HEIGHT SPECTROSCOPY. Hartmann, G.; Klein, J. W.; Faatz, H. (Frieseke and Hoepfner GmbH, Erlangen, Ger). Nucl. Instrum. Methods; 102: No. 2, 361(1972).

An improved method for livetime correction in pulse height spectroscopy has been investigated, which tries to overcome the error introduced by the usual methods. (auth)

High Energy Physics Instrumentation

43103 (CERN-72-6) DESIGN AND CONSTRUCTION OF A SPARK GAP ASSEMBLY AND ASSOCIATED CIRCUITS. Hubbeling, L. (European Organization for Nuclear Research, Geneva (Switzerland)). 4 Apr 1972. 11p. Dep. NTIS (U. S. Sales Only).

The electronic circuit and performance of a spark gap assembly are described. This assembly gave 150 nsec pulses up to 10 kV into a 6 Ω load at a repetition time of 12 msec and was used for driving a number of large-area spark chambers. Mechanical details are given of a modified version of the spark gap that was actually used. A fast trigger circuit delivering 10 to 15 kV pulses with a delay of about 60 nsec is also described. For protection of the spark chambers and other equipment, a monitoring device switches off the high-voltage power supplies should one of the gaps break down. (auth)

43104 ENERGY DEPOSITION IN IONIZATION SPECTROMETERS. Gabriel, T. A.; Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 536-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43105 PROPOSED DETECTOR ASSEMBLY FOR IDENTIFICATION OF HEAVY-MASS COSMIC-RAY NUCLEI OF LOW ENERGIES. Muga, M. Luis (Univ. of Florida, Gainesville). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 384-7(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A description is given of a proposed new particle detector capable of measuring dE/dx and residual energy values of energetic heavy-mass cosmic-ray nuclei ($Z > 26$) with energies as low as 1 MeV/nucleon, a region of information not accessible by other known means. The unique advantages of this detector assembly as it is envisaged for space flight experiments are listed. (5 figures) (auth)

43106 PROPORTIONAL CHAMBER SYSTEM FOR THE SLAC 20-GeV SPECTROMETER. Bloom, E.; Cottrell, R. L. A.; Johnson, G.; (and others) (Stanford Univ., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 495-501(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A 400-wire proportional chamber system was used in two electron scattering experiments with the SLAC 20-GeV spectrometer. Chamber construction and associated electronics are described in detail, and the resultant performance during data taking (over a three-month period) is discussed. (10 figures) (auth)

43107 CAMAC DISCRIMINATOR-GATED LATCH WITH DIGITAL MULTIPLICITY LOGIC, TITO. Bertolucci, B.; Horelick, D.; Rosche, F. (Stanford Univ., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 526-33(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A 16-channel discriminator-gated latch CAMAC module using MECL II was designed and built for use in a phototube trigger hodoscope array. The module includes individual discriminator outputs, analog summing outputs, and high-speed digital multiplicity outputs which are processed by an "analyzer" in order to decide if the particle multiplicity is suitable for streamer chamber firing. Latch data are transmitted to a PDP-9 for recording and further processing. (9 figures) (auth)

43108 HIGH-RESOLUTION, MULTIPLE-PARTICLE SPECTROMETER FOR THE MEASUREMENT OF SOLAR-PARTICLE EVENTS. Reagan, J. B.; Bakke, J. C.; Kilner, J. R.; Matthews, J. D.; Imhof, W. L. (Lockheed Palo Alto Research Lab., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 554-61(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A particle spectrometer possessing high spectral and spatial/temporal resolution for the measurement of energetic protons, electrons, and alpha particles over a broad energy and intensity range during solar particle events (SPE) was successfully launched aboard a polar-orbiting satellite on 17 October 1971. The spectrometer consists of a multielement silicon detector stack mounted within a plastic scintillator guard counter to form a particle telescope. The spectra of protons in the energy range 1.2 to 100 MeV, electrons from 0.88 to 1.6 MeV, and alpha particles from 1.6 to 500 MeV are measured in four time-shared modes of operation with dual 256-channel pulse-height analyzers (PHA) of the successive-approximation type. Integral counting rates from each of the main elements of the telescope and the guard counter are measured every 32 milliseconds with low-power CMOS digital counters to provide high spatial/temporal resolution on the solar particle fluxes. Complete spectra on all three particle types over the above energy ranges are obtained every few seconds. A detailed description of the spectrometer, including a discussion of the mode logic which enhances the counting statistics in selected energy ranges, the dual pulse-height analyzers, and the methods of obtaining the high temporal resolution is presented. Preliminary worldwide flight data obtained from two identical spectrometers oriented at different directions to the particle flux are also presented. (7 figures, 1 table) (auth)

43109 ELECTRON SCATTERING EFFECTS IN TYPICAL COSMIC-RAY TELESCOPES. Lupton, J. E.; Stone, E. C. (California Inst. of Tech., Pasadena). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 562-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Laboratory measurements were made of the response of two typical cosmic-ray detector systems to electrons between 0.2 and 2.0 MeV. The detector systems investigated were included in the Caltech Solar and Galactic Cosmic-Ray Experiment aboard NASA's OGO-VI spacecraft and the Chicago/Caltech Low-Energy Cosmic-Ray Experiment aboard OGO-IV. Working laboratory versions of each of these particle telescopes were exposed to the monoenergetic electron beam from a magnetic spectrometer. The results of pulse height and counting-rate measurements indicate that electrons scattered from the anti-coincidence cup comprise about 25% of the total number arriving at the top of the detector stack. In certain cases, the contribution of these scattered particles to the total number of electrons detected can reach 65%. Suggestions are made for applying these results to other detector systems. (7 figures, 2 tables) (auth)

43110 DIGITIZING AND MEMORY SYSTEM FOR WIRE SPARK CHAMBERS. Friday, R. G.; Mauro, K. D. (Stanford Univ., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 706-11(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A new digitizing and memory system for use with magnetostrictive wire spark chambers is described. Features include a 1000 spark per event, 20-MHz shift register memory and a live CRT display of spark positions. Design experience with state-of-the-art MOS shift registers and Schottky TTL circuits is presented, together with comments on experience with the working system. This principle has applications in many other situations requiring the digitization and storage of the arrival times of a burst of pulses. (9 figures) (auth)

43111 COMPUTER SYSTEM FOR MULTIPARAMETER PULSE-HEIGHT ANALYSIS AND CONTROL. Friday, R. G.; Mauro, K. D. (Stanford Univ., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 726-30(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A multiparameter pulse height analyzer and computer control system are described. Features include individual peak-hold detectors with a time-shared ADC front end driving a PDP-9 computer to measure time-of-flight and light intensity from 12 scintillation counters around the 40-inch hydrogen bubble chamber. (8 figures) (auth)

43112 AUTOMATIC DEVICE FOR SCANNING BUBBLE CHAMBER FILM AND IDENTIFYING EVENTS IN THEM. Heifets, S. A.; Kharitonov, V. M. Russian Patent No. 276,266. 29 Aug 1970. Filed 3 Jul 1968. (In Russian).

Automatic means for recovering data from bubble chamber plates are described. The device includes a projection arrangement, scanning table, and means for moving the plate, as well as means to reduce background effects and increase processing speed. (1 figure) (R.W.R.)

Radiometric Instruments

Refer also to abstract 42704.

43113 NOMOGRAPH FOR X-RAY DIFFRACTION AND X-RAY SPECTROSCOPY. Srinivasa, V. K.; Banerjee, B. K. (Fertilizer Corp. of India Ltd., Sindri). Technology (Sindri); 7: No. 4, 323-5(Oct-Dec 1970).

A nomograph was drawn on the basis of the equation $n\lambda = 2d \sin\theta$ for determining the (i) interplanar distances d vs 2θ and vice versa for any characteristic radiation of the target element, such as molybdenum, copper, cobalt, iron and chromium element (ii) to two-theta (2θ) and vice versa for the appropriate series and line for the crystals, Topaz, lithium fluoride, sodium chloride, EDDT and ADP, used in X-ray fluorescent spectrometers. (auth)

43114 HIGH-TEMPERATURE DENSITY MEASUREMENTS USING GAMMA RAYS FROM A CESIUM SOURCE. LeVert, F. E.; Dillon, I. G.; Tarng, H. J. (Tuskegee Inst., Ala.). Trans. Amer. Nucl. Soc.; 15: No. 1, 174-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43115 TOTAL POLLUTION SYSTEM MONITORING (TOPOSYM). Badgett, Charles O. (Industrial Nucleonics Corp., Columbus, Ohio). Isotop. Radiat. Technol.; 9: No. 3, 278-9 (Spring 1972).

The use of radioisotopic instruments for total pollution system monitoring is briefly discussed. The concept provides for controlling industrial pollution in the plant itself, i.e. in the process where the pollutant occurs or is formed or at the point where it might be released to the environment. Radioisotopic instruments can be used to determine the pollutant in the raw material, at any stage of the processing, and in the effluent and can be coupled with control instruments to stop the process whenever limits are exceeded. (W.H.K.)

43116 DESIGN OF GAMMA-BACKSCATTER DENSITY GAGES. Taylor, D.; Pirie, E. (Univ. of Strathclyde, Scotland). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 233-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The importance of studying case histories in courses of instruction on nuclear instrumentation is pointed out: the byproducts of such studies can often provide useful research projects. The case of the gamma backscatter density gage is considered as a specific example. Starting from the original type of gage, using a fixed source–detector separation in which a counting rate vs density chart is employed, the authors discuss the elimination of "soil type" effects, the anomalous behavior of hydrogen, and the new moving-source (variable source–detector distance) gage and the advantages which it offers (e.g., no calibration is necessary). Finally, more recent work is described showing how the density gage may be employed for measuring the moisture content of materials as well as the density. (6 figures) (auth)

43117 TELEMETERED PROFILING ISOTOPIC SNOW GAGE. Coates, R. A.; Johnson, L. O.; Killian, E. W.; (and others) (Aerojet Nuclear Co., Idaho Falls, Idaho). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 239-42(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The profiling isotopic snow gage measures the density of horizontal layers of snow by observing the attenuation of gamma rays that pass through a fixed thickness of snow. It consists of two parallel vertical access tubes extending from the ground through the snow. One contains a 10-mCi ^{137}Cs source; the other, a scintillation detector. These are suspended at equal heights on thin cables and moved up and down the tubes by a motor. The count rate recorded in successive snow layers is used to obtain a snow-density profile. The design and performance of the gage, operated in a remote location by the telemetry, are described. (3 figures) (R.W.R.)

Radiation Effects on Instrument Components, Instruments, and Electronic Systems

Refer also to abstracts 44532 and 44544.

43118 (SC-DR-720418) PREDICTION OF THE EFFECTS OF RADIATION ON THE SATURATION VOLTAGE OF POWER TRANSISTORS. Shafer, B. D.; Horning, L. K. (Sandia Labs., Albuquerque, N. Mex.). Jun 1972. 26p. Dep. NTIS.

The mechanisms for increases in saturation voltage as a result of neutron radiation are examined. It is concluded that the width of the collector epitaxial layer is the most important parameter in determining the susceptibility of a high voltage, high current device to radiation-induced increases in saturation voltage. It is shown that a particular type of storage time measurement should provide information about the epitaxial layer width, and therefore the individual device hardness. Experimental results indicate that storage time used in conjunction with low voltage, high current gain measurements provided sufficient information to categorize devices within a given group as to their respective hardness. (auth)

43119 ANNUAL CONFERENCE ON NUCLEAR AND SPACE RADIATION EFFECTS, DURHAM, NEW HAMPSHIRE, JULY 20–23, 1971. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 1-456(Dec 1971). (CONF-710709).

Sixty papers are included, and a separate abstract was prepared for each of fifty-two. Two papers were not considered in scope, and six had previously appeared in NSA; see NSA Vol. 25, Abst. Nos. 44743–44746, 46662, and 55079. (M.H.R.)

For abstracts of individual papers see: 43005, 43066, 43120–43154, 44468–44472, and 44526–44535.

43120 SHORT-TERM ANNEALING IN TRANSISTORS IRRADIATED IN THE BIASED-OFF MODE. Mallon, C. E.; Harrity, J. W. (Gulf Radiation Tech., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 45-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A set of experiments were performed at the White Sands Missile Range Fast-Burst Reactor Facility in which measurements were made of the annealing of three types of transistors (two NPN and one PNP) which were irradiated while biased off. Anneal factors as high as 5 or 6 were observed in the NPN devices when turned on tens of milliseconds after the neutron burst. The PNP device (2N2875) showed an anneal factor of nearly 4 when turned on 29 msec after the radiation pulse. The injection dependence of the annealing is clearly evident. (auth)

43121 STUDY OF IONIZING RADIATION DAMAGE IN MOS STRUCTURES USING INTERNAL PHOTOEMISSION. Peel, J. L. (North American Rockwell, Anaheim, Calif.); Eden, R. C. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 84-90(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The effects of ionizing radiation in large-geometry MOS structures were studied by use of internal photoemission techniques. Barrier heights at both the silicon–silicon dioxide and the silicon dioxide–metal (chromium and aluminum) interfaces were measured before and after irradiation in a ^{60}Co gamma cell. It was determined that the measured barrier energy heights may be considerably reduced by radiation-induced oxide charge. The internal photoemission technique also provided significant information concerning the effects of impurities in the oxide and the related radiation hardness of the oxide layer. Oxide layers doped with chromium ions showed significant electron trapping at two discrete energy levels (3.4 and 3.8 eV). Samples exhibiting the 3.4 eV level showed great radiation hardness, while those with only the 3.8 eV peak were very radiation soft. The information obtained, using the internal photoemission technique, has provided considerable insight into the mechanisms and fabrication processes associated with radiation-hardened MOS devices. (auth)

43122 RADIATION AND OXIDE–METAL INTERACTIONS IN MOS. Lindmayer, J. (COMSAT Labs., Clarksburg, Md.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 91-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Radiation stability of the MOS system is controlled by the oxide–silicon and oxide–metal barriers; oxide–metal interactions and certain dopants appear to affect the radiation sensitivity. It is shown that the OS system behaves differently from the MOS system. The effect of metals has been studied with the use of aluminum, molybdenum and chromium. Chromium appears to be a desirable metal; when this electrode is used other factors also assume importance. The best results obtained with chromium gate p-enhancement transistors are: a shift of only 1.5 V ($\sim 10^{11}$ charges/cm^2) with a Co-60 source depositing 2×10^7 rad (Si) or 1.5 MeV electrons depositing 10^{14} electrons/cm^2. The change in surface mobility is small. Isothermal relaxation experiments show a wide range of activation energies, some of which are characteristic of the metal used. Studies related to the "photo-current" flowing during irradiation appear to indicate that the prevailing model for radiation "damage" must be altered. (auth)

43123 SHORT-TERM CHARGE ANNEALING IN ELECTRON-IRRADIATED SILICON DIOXIDE. Simons, M. (Research Triangle Inst., Research Triangle Park, N. C.); Hughes, H. L. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 106-12(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The existence of a rapid annealing phase in the decay of space charge induced in silicon dioxide by pulsed irradiation has been demonstrated. This effect has been observed in MOS structures prepared from both wet and dry thermal oxides and also in several commercial N-channel MOSFET's. A simple model involving thermal release of the trapped positive charge from a distribution of oxide trapping levels conveniently approximates the major features of short-term annealing. (auth)

43124 RADIATION HARDENING OF p-MOS DEVICES BY OPTIMIZATION OF THE THERMAL SiO_2 GATE INSULATOR. Aubuchon, Kenneth G. (Hughes Aircraft Co., Newport Beach, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 117-25(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

It has been found for p-channel MOS devices that considerably better radiation tolerance than generally believed possible can be obtained with gate insulators of thermally grown SiO_2, provided that the processing conditions are optimized for radiation resistance. The oxidation ambient and temperature, the post-oxidation annealing temperature, the silicon orientation, and the method of depositing the gate metal all have pronounced effects on the radiation-induced degradation. With these parameters optimized for radiation hardness, gate threshold shifts of less than one volt after 1×10^6 rads (Si) can be obtained over the entire range of gate biases from 0 to −30 volts. These findings and their applicability to the fabrication of radiation-hardened MOS circuits are described. (auth)

43125 ELECTRONIC RECOVERY FROM RADIATION EFFECTS IN CMNOS STRUCTURES. Cricchi, J. R.; Barbe, D. F. (Westinghouse Electric Corp., Baltimore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 126-30(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The effects of ionizing radiation on Complementary Metal-Nitride-Oxide-Silicon structures for oxide thicknesses in the range of 20−50 Å are considered. The bi-directional radiation-induced threshold-voltage shifts in CMNOS structures are interpreted in terms of charge accumulation at the nitride-oxide interface. The electronic recovery of pre-irradiation threshold voltage levels by carrier transport through the thin oxide is shown experimentally. (auth)

43126 RELAXATION PHENOMENA ASSOCIATED WITH RADIATION-INDUCED TRAPPED CHARGE IN Al_2O_3 MOS DEVICES. Micheletti, F. B.; Kolondra, F. (RCA Labs., Princeton, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 131-7(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A semi-quantitative model based on enhanced electron injection due to radiation-induced trapped positive charge in Al_2O_3−MOS devices is developed. This is found to explain the main features of the charge relaxation phenomena observed following termination of radiation with applied gate bias. This model provides for the existence of both negative and positive charge trapping sites in accordance with the results of other workers. Under certain conditions, internal recombination of trapped holes and electrons was found to play an important role in the relaxation process. However, in cases normally encountered in typical device operation, the relaxation was found to be nearly identical to the bias induced shift due to electron injection if one compares the phenomena for the same fields at the injecting contact. With positive gate bias, this is done by subtracting the shift in flat-band voltage introduced by the radiation-induced trapped charge from the applied gate bias. Finally, the dependence of the net radiation-induced charge on gate bias and dose rate was found to be consistent with the picture developed to explain the relaxation effects. The radiation hardness of Al_2O_3−MOS devices is attributed at least in part to enhanced electron injection due to the high fields caused by the accumulation of positive charge in the oxide near the injecting electrode. These results show that radiation hardness increases rapidly with decreasing oxide thickness. Practical consideration involving device stability suggests that a thickness in the range of 700 Å to 800 Å is optimum. (auth)

43127 PREPROGRAMMED NONVOLATILE METAL-OXIDE-SEMICONDUCTOR MEMORY BY USE OF IONIZING RADIATION. Ferber, R. R. (Westinghouse Electric Corp., Pittsburgh). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 138-40(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A technique of "burning in" a preferred state in Metal-Oxide-Semiconductor (MOS) memory cells using ionizing radiation such as electron bombardment or X-rays is described. When the memory power is removed and reapplied, the memory will always configure itself to the preset information pattern while still allowing normal electrical alteration of stored information in either random access memory (RAM) or shift register configuration memory chips. Potential applications of this data "burn in" technique are as an additional or improved method of fabrication of read only semiconductor memories 'ROM' and reprogrammable read only memories. Considerable application also exists for a memory which can be caused to turn on in a particular information pattern each time power is interrupted and reapplied and still operate after turn on as an ordinary electrically alterable memory. (auth)

43128 CONSIDERATIONS IN ESTABLISHING A STANDARD FOR NEUTRON DISPLACEMENT ENERGY EFFECTS IN SEMICONDUCTORS. Conrad, Edward E. (Harry Diamond Labs., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 200-5(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Over the past several years a number of semiempirical or theoretical curves have been generated to represent the neutron-induced displacement effects in silicon as a function of neutron energy. Since the mode of failure for most silicon semiconductor devices is a loss of gain and this is, in turn, proportional to the reduction in carrier lifetime the same curves are used to express both the neutron energy damage effectiveness for devices as well as the degradation of lifetime. A useful feature of such a curve is that the damage produced in a semiconductor by a neutron fluence of a given energy spectrum may be predicted by folding the spectral information together with the damage curve. Once this is done, the damage may be expressed as that resulting from an equivalent monoenergetic neutron source (the monoenergetic equivalent). This procedure enables the results of an exposure to a source of one spectrum to be used to predict the effects of a different one. In order for this technique to be useful as a means of communication there must be some standardization of the damage curve, the neutron energy to which the damage is referred and the description of the spectrum. Recent interest, throughout the radiation effects community, in establishing such a standard has prompted several proposals each of which contains some shortcomings. The various deficiencies and merits are compared and what constitutes a minimum set of requirements for standardization is decided. These requirements are based upon the state of the art in neutron dosimetry, current understanding of the physics of initial displacement effects, the formation of stable damage, the kinetics of annealing, how these concepts relate to the macroscopic properties of devices, and practicability. (auth)

43129 DEVICE CHARACTERIZATION FOR COMPUTER ANALYSIS OF LARGE CIRCUITS. Lindholm, Fredrik A. (Univ. of Florida, Gainesville). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 206-11(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

How systematic selection of transistor models can be incorporated into the computer simulation of circuit behavior is described. The selection is so done that each model chosen provides the best accuracy-simplicity compromise for the circuit environment in which each transistor resides. Compared with other procedures now available, the method described simplifies computation, saves computational cost, and enables simulation of larger circuits. Applicability to the simulation of circuit behavior in a radiation environment is discussed. (33 references). (auth)

43130 SIMPLIFIED TERMINAL MODELS OF COMPLEX LINEAR MICROCIRCUITS FOR USE IN COMPUTER AIDED SYSTEMS ANALYSIS. Pocock, D. N.; Raymond, J. P. (Northrop Corporate Labs., Hawthorne, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 212-19(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Results are presented on a generalized approach to derive radiation-inclusive simplified terminal models of linear microcircuits for use in computer aided systems analysis. The resulting models represent the complex driving-point impedances, the forward and reverse voltage transfer functions, and the ionizing-radiation induced transient photoresponse. The technique has been demonstrated by generating a terminal model of the μA709 operational amplifier, with the resulting model having 50 times fewer elements than the "detailed" model. (auth)

43131 COMPUTER-AIDED SYSTEM APPROACH TO THE RADIATION VULNERABILITY OF A DIVIDE BY TWENTY COUNTER. Lubell, J. I.; Gratt, L. B. (TRW Systems, Redondo Beach, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 220-6(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A practical approach to modeling large systems in terms of simplified component models is presented. The modeling approach uses a state variable formulation and provides practical techniques for predicting the transient response of large, closed loop systems using presently available computer-aided circuit analysis programs. A simplified terminal model for a J-K flip-flop is developed, and five flip-flop models are used to model a divide by twenty counter. Using the "system" model, the response of the counter in an ionizing radiation environment is determined. (auth)

43132 SIMPLIFIED MICROCIRCUIT MODELING. Dickhaut, R. H. (Braddock, Dunn and McDonald, Inc., Albuquerque, N. Mex.) IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 227-36(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A simple and efficient approach to integrated circuit (IC) modeling for both normal and radiation effects behavior is described. The modeling techniques are sufficiently general that no characteristics data are required for devices used in any IC, and extensions to either digital integrated circuits or MSI/LSI are possible with only minor modifications. These features resulted from a development philosophy that was oriented toward reducing the number of differential equations to an absolute minimum and incorporating only parameter dependencies which refer directly to input-output conditions. (auth)

43133 NUCLEAR RADIATION INTERFERENCE AND DAMAGE EFFECTS IN CHARGED-PARTICLE EXPERIMENTS FOR EXTENDED SPACE MISSIONS. Trainor, James H.; Teegarden, Bonnard J. (Goddard Space Flight Center, Greenbelt, Md.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 237-42(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Problems from radiation interference and damage effects on spacecraft instrumentation from on-board radioactive thermoelectric generators and from radiation belts (particularly Jupiter) are discussed. (W.H.K.)

43134 RADIATION-RESPONSE STUDY OF NEW RADIATION-HARDENED LOW-POWER TTL SERIES. Olson, R. J.; Alexander, D. R.; Antinone, R. J. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 243-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The radiation response of the RSN54L series of low power TTL logic circuits was observed after exposure to flash X-ray, neutron, and electron beam environments. Several matching types of memory and non-memory SN54L circuits were irradiated in the flash X-ray environments forming a transient hardness comparison of the hardened and standard low power families. Both DC and switching electrical specification measurements were made on four hundred and eighty (480) RSN54L gate circuits. These terminal measurements served as a monitor for the permanent degradation effects from neutron irradiation. Wide pulse and catastrophic failure tests were run using the electron beam. The RSN54L circuits were found to survive a neutron fluence of 1×10^{14} n/cm^2 (1 MeV equivalent) at full fanout. They survived a total dose in the electron beam of 1×10^8 Rad(Si) and had a transient failure threshold higher than 3×10^9 Rad(Si)/s. (auth)

43135 CHARACTERISTICS OF MOS CIRCUITS FOR RADIATION-HARDENED AEROSPACE SYSTEMS. Kjar, R. A.; Bell, J. E. (North American Rockwell, Anaheim, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 258-62 (Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

In the past, Metal-Oxide-Semiconductor (MOS) circuits have been unsuitable for many aerospace applications because of their sensitivity to permanent and transient radiation effects. Radiation test data on hardened p-channel MOS (PMOS) transistors now show that most permanent radiation damage can be prevented in PMOS circuits. Also, hardened PMOS transistors and circuits have been built utilizing a silicon-on-sapphire (SOS) isolation technique to minimize transient radiation effects. Analyses of dynamic and static PMOS/SOS NOR gates show that, with the electrical and radiation-hardness characteristics already attained in discrete transistors, the following circuit performance levels can be expected. Dynamic PMOS/SOS circuits will operate at 5 MHz clock rates and 112 μW/gate power levels and will tolerate radiation levels above 10^7 rads (Si), 10^{15} n/cm^2, and 10^9 rads(Si)/sec. Static circuits will exhibit logic delays of about 30 ns/gate at power levels of 0.37 mW/gate and will also tolerate radiation levels above 10^7 rads(Si), 10^{15} n/cm^2 and 10^9 rads(Si)/sec. These performance and radiation hardness characteristics appear to be achievable for large-scale-integration (LSI) of PMOS/SOS circuits, utilizing commercially-proven process techniques. (auth)

43136 MODELING AND RADIATION EFFECTS STUDY OF AN LSI/MOS LOGIC SYSTEM. Habing, D. H.; Shafer, B. D. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 263-72(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The results of a comprehensive modeling and radiation effects study of a p-channel enhancement mode LSI/MOS test chip (TC) specifically designed to allow measurement of discrete device type parameters and responses for circuits constructed from similar devices on a common chip are presented. Particular emphasis was given to the development of accurate models of the individual devices and to the demonstration of the use of these models in predicting the radiation responses of the circuits on the chip. Ionization dose and neutron effects were determined for each of the parameters used in the model which contained the basic Sah equations modified to include channel length modulation effects, the body effect, and the electric-field-dependence of channel mobility. Average values of these parameters were then used in predictions of pre- and post-radiation responses for circuits. (auth)

43137 TRANSIENT IONIZING RADIATION EFFECTS IN MOS/LSI. Raymond, J. P.; Pocock, D. N. (Northrop Corporate Labs., Hawthorne, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 288-94(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Transient ionizing radiation effects data on six types of MOS/LSI devices are presented considering variations in the pulse width of the radiation environment and circuit design of the MOS/LSI cell. Four of the device types employed dynamic logic cells and the other two were formed with static logic cells. Transient failure levels of the dynamic arrays occurred with exposure to a total radiation dose of 1 to 10 rads(Si) through a time as long as 5 ms. The static logic arrays demonstrated significant transient responses at radiation levels of 10^8 rads(Si)/s, or transient failure of stored information with exposure to a total radiation dose of 10—50 rads(Si). (auth)

43138 EFFECTS OF IONIZING RADIATION ON GUNN DIODE OSCILLATORS. Berg, N.; Dropkin, H. (Harry Diamond Labs., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 295-303(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The results of an investigation of the performance of both 100 mW cw and 5-Watt pulse-mode 5-GHz Gunn diodes subjected to dose rates of 10^8 to 5×10^{10} Rad(Si)/s are presented. Two modes of failure for Gunn diode microwave oscillators exposed to high intensity gamma ray pulses were found including temporary cessation of power output and avalanche breakdown where large currents surge through the diode. It is shown that the negative resistance phenomenon and associated Gunn effect are not quenched by ionizing radiation. (W.H.K.)

43139 TRANSIENT RADIATION EFFECTS IN SILICON DIODES NEAR AND IN AVALANCHE BREAKDOWN. Shedd, W.; Buchanan, B.; Dolan, R. (Air Force Cambridge Research Labs., Bedford, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 304-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Results of experiments on silicon diodes with a range of breakdown voltages from 5.7 to 85 volts are presented for ionizing dose rates from 10^7 to 8×10^9 rads/s for a wide variety of bias conditions near and in avalanche breakdown. Results of experiments to determine the effectiveness of various hardening techniques are also presented. The transient response of especially designed neutron hardened, temperature compensated, voltage reference diodes are determined, for the purpose of evaluating the consistency of permanent neutron and transient ionizing hardening techniques. The effect of the temperature compensating junction for OTC diodes on transient current is presented and the transient response of voltage regulating diodes is evaluated as a function of the circuit providing bias current to the diode as well as the impedance of the circuit that the reference diode drives. A model that is appropriate to diodes operating in avalanche breakdown and in an ionizing radiation environment is also presented. (auth)

43140 EXPERIMENTAL DETERMINATION OF THE GENERATION RATE CONVERSION FACTOR USING A PULSE OF IONIZING RADIATION OF ARBITRARY SHAPE. Neamen, D. A.; Grannemann, W. W. (Univ. of New Mexico, Albuquerque). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 318-21(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A method was developed to determine experimentally the generation rate conversion factor, g_0 (electron-hole pairs/m^3-rad), using a pulse of ionizing radiation of arbitrary shape. The method involves measuring the photocurrent response of a p-n or Schottky barrier diode as a function of the applied reverse-bias voltage to the diode. The slope of the peak photocurrent versus $(V_{bi} + V_R)^{1/2}$ curve is used to calculate the value of g_0. The method was applied to Si, GaAs, and $GaAs_{0.5}P_{0.5}$ Schottky barrier diodes. The experimentally determined values were within ±7.5 percent of the accepted values in the case of silicon and gallium arsenide. The value of g_0 for $GaAs_{0.5}P_{0.5}$ was found to be 7.45×10^{19} electron-hole pairs/m^3-rad. (auth)

43141 RADIATION EFFECTS IN ELECTROLUMINESCENT DIODES. Barnes, C. E. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 322-31(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Following a brief discussion of the operating characteristics of light emitting diodes (LED's), radiation effects in these devices are reviewed. Recent results on neutron damage effects in SiC LED's are also presented. Based on this review, criteria are developed for radiation insensitivity of LED's. (auth)

43142 JFET TRANSIENT RADIATION RESPONSE. Long, David M. (General Electric Co., Philadelphia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 332-9 (Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709

A comprehensive study of transient radiation response mechanisms in Junction Field Effect Transistors at dose rates less than 1×10^{10} Rad (si)/sec has been performed. Theoretical models of device response have been developed and represented in terms of a large signal equivalent circuit model. Experimental verification has been achieved through radiation testing at the AFCRL Linac Facility on specially built JFETs supplied by Siliconix, Inc. Conclusions are presented. (auth)

43143 EFFECTS OF IONIZING RADIATION ON THIN-FILM SEMICONDUCTOR DEVICES. Srour, J. R. (Northrop Corporate Labs., Hawthorne, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 359-65(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Results of an investigation of the transient and permanent effects of ionizing radiation on Al_2O_3-CdSe thin-film transistors and microcircuits are reported. The total-gamma-dose response of the devices did not differ significantly from that of conventional silicon MOS devices, and the observed shift in threshold voltage is consistent with a positive charge buildup in the gate oxide. In transient response studies, it was found that the thin-film devices will perform without failure up to peak dose rates of $\sim 10^{10}$ rads(Si)/s (~30 ns pulsewidth). (auth)

43144 NEUTRON-DAMAGE EFFECTS IN STEP-RECOVERY-DIODE FREQUENCY MULTIPLIERS. Chaffin, R. J. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 366-70(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The Step-Recovery Diode (SRD) frequency multiplier has been studied both theoretically and experimentally. The results show that the multiplier is quite susceptible to neutron damage if self-bias is used (which is usually the case) and it is recommended either that the preradiation lifetime should be deliberately shortened or that voltage bias be considered in a radiation environment. The self-bias problem is found to be due to an increase in recombination current brought on by a reduction in minority carrier lifetime with neutron fluence. This study also derives the ultimate failure fluence as a function of multiplier parameters for these multipliers in general. (auth)

43145 DAMAGE AND RECOVERY CHARACTERISTICS OF LITHIUM-CONTAINING SOLAR CELLS. Faith, T. J. (RCA Astro-Electronics Div., Princeton, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 371-7(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Damage and recovery characteristics were measured on lithium-containing solar cells irradiated by 1-MeV electrons. Empirical expressions for cell recovery time, diffusion-length damage coefficient immediately after irradiation, and diffusion-length damage coefficient after recovery were derived using results of short-circuit current, diffusion-length, and reverse-bias capacitance measurements. The damage coefficients were expressed in terms of a single lithium density parameter, the lithium gradient. A fluence dependence was also established, this dependence being the same for both the immediate-post-irradiation and post-recovery cases. Cell recovery rates were found to increase linearly with lithium gradient and vary approximately as $\phi^{-0.59}$. (auth)

43146 NEUTRON IRRADIATION EFFECTS ON DIFFUSED GaAs LASER DIODES. Noel, B. W. (Univ. of New Mexico, Albuquerque); Barnes, C. E.; Southward, H. D. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 378-86 (Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The effects of fast neutron damage on diffused GaAs laser diodes have been studied by observing the pre- and post-irradiation current-voltage characteristics and electroluminescence (EL) spectra at several temperatures between 75 and 300°K. The preirradiation diode current at high temperature is dominated by nonradiative space-charge region recombination. The principal emission band at 300°K results from band-to-acceptor recombination in the p-region. A secondary band at 1.28 eV occurs via donor-acceptor pair recombination in the depletion region. At low temperature the dominant diode current flow is by nonradiative tunneling while the principal emission band contains radiative tunneling and band-filling components. Neutron irradiation increases the constant-voltage diode current. The additional current is due to space-charge region recombination (SC) at high temperatures and both SC and tunneling at low temperatures. The room-temperature damage constant is somewhat larger than that found in epitaxial GaAs laser diodes and in silicon p^+n diodes. The constant-voltage principal emission band intensity decreases with fluence at a rate such that the resultant damage constant is about half that of the SC current damage constant. Irradiation to a fluence of 1.8×10^{15} n/cm^2 (>10 keV) has no effect on the constant-voltage secondary emission band intensity. (auth)

43147 EXPERIMENTAL DETERMINATION OF GAIN DEGRADATION MECHANISMS. George, William; Clark, Lowell (Motorola Semiconductor Products Div., Phoenix, Ariz.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 387-92(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Experimental means for identifying the sources of neutron-induced base current in bipolar transistors are presented and discussed. Several examples illustrate the predominant determinants of post-irradiation current gain, and the methods facilitate intercomparison of disparate devices. The techniques cited are equally applicable to the study of current-gain and recombination in unirradiated devices. (auth)

43148 ROLE OF EMITTER AREA IN NEUTRON-HARDENED TRANSISTOR DESIGN. Smith, Daniel M.; Hahn, Larry A. (Texas Instruments Inc., Dallas). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 393-6(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Using Hauser's equation for the current dependence of effective emitter area in Hahn's epitaxial transistor model, it is predicted that emitter debiasing appreciably increases the equilibrium collector resistance of a transistor having a structure typical of neutron-hardened transistors. To experimentally determine whether debiasing is as severe as predicted, a small transistor and an adjacent emitter-shaped resistor were fabricated on the same chip. Near coincidence of the emitter-shaped resistor I-V characteristic with the transistor saturation locus, before and after irradiation to neutron fluences up to 5×10^{14} n/cm^2 (E > 10 keV), demonstrates that emitter debiasing is not important in determining the saturation locus (onset of h_{FE} falloff with collector current) in transistors having a moderate emitter stripe width (2 mils). It is concluded that extremely narrow emitter stripe widths are not needed for neutron-hardened transistors. (auth)

43149 RADIATION RESPONSES OF MATCHED SILICON JUNCTION FIELD-EFFECT TRANSISTORS. Notthoff, J. K. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 397-403(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709

Experimental data on the responses of matched silicon JFET's subjected to neutron burst, neutron steady-state, and pulsed gamma radiation are presented. Temporary and permanent degradation of device parameters and their change of matching parameters as functions of neutron fluence and ionizing dose rate are discussed. A procedure for selection of matched JFET pairs is suggested. An existing method for calculating the degradation of g_m was found to be useful but required a slight modification to fit experimental data. (auth)

43150 EFFECT OF ^{60}Co GAMMA RADIATION ON NOISE PARAMETERS OF BIPOLAR TRANSISTORS. Prince, J. L.; Stehlin, R. A. (Texas Instruments Inc., Dallas). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 404-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709

Bipolar-transistor noise current and noise voltage were examined in the range from 100 Hz to 20 kHz as a function of γ-dose from $\gamma = 10^5$ Rad(Si) to $\gamma = 1.1 \times 10^7$ Rad(Si). A variety of geometries of both NPN and PNP types were utilized. Substantial changes in i_{nT} were found for all device types but v_{nT} changed in only certain device types. (auth)

43151 CAPACITANCE VOLTAGE CHARACTERISTICS OF NEUTRON-IRRADIATED n^+pp^+ AND p^+nn^+ JUNCTIONS. Crabbe, James S. (Texas Instruments Inc., Dallas). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 410-19(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709

The small signal capacitance—voltage characteristics of neutron irradiated p^+nn^+ and n^+pp^+ diodes are described. The capacitance characteristics were measured at frequencies of 1 kHz, 10 kHz, 100 kHz and 1 MHz for five neutron fluences. A qualitative difference in the effect of neutron fluence on the capacitance characteristics of p^+nn^+ and n^+pp^+ diodes is described. A computer aided device model which is based on an equivalent circuit representation of two deep defect levels is described. The capacitance characteristics of neutron irradiated p^+nn^+ diodes with three different pre-radiation resistivities were computed using the device model representation of two deep acceptor levels. The computed curves are in good agreement with the measured characteristics. (auth)

43152 PERMANENT NEUTRON DAMAGE IN PIN MICROWAVE DIODE SWITCHES. Chaffin, R. J. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 429-35(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The microwave PIN diode and its associated circuitry have been studied both experimentally and theoretically. The results of the study show that microwave PIN switches are very susceptible to permanent neutron damage. The failure mechanism is a severe reduction of conductivity modulation in the diode's I region caused by a reduction of carrier lifetime. This loss of conductivity modulation not only causes a reduction of the isolation abilities of a microwave switch but is also shown to lead to other secondary failure modes which can be extremely important. (auth)

43153 IONIZING RADIATION EFFECTS IN MICROWAVE CAVITIES. Chaffin, R. J. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 436-8(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709

Recent studies of the effects of ionizing radiation on microwave Gunn oscillators have neglected the effect of the ionizing radiation on the gas inside the microwave cavities used as part of the oscillator circuit. It is shown both theoretically and experimentally that this effect cannot be neglected above dose rates of 10^8 Rad/sec. (auth)

43154 MSI TESTING AT DOSE RATES FROM 10^9 TO 10^{12} RAD (Si)/S. Alexander, D. R.; Antinone, R. J. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 439-42(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A group of seven different types of medium scale integrated circuits (MSI) were tested at dose rates from 10^9 to 10^{12} Rad (Si)/s. These included five types of bipolar circuits and two types of MOS circuits. Catastrophic failures were encountered in two types of bipolar circuits and one type of MOS circuit. Radiation response of all circuits is described. (auth)

43155 GAMMA-RAY BACKGROUND TO HEAO EXPERIMENTS FROM SPACECRAFT RADIOACTIVITY. Stauber, M. C. (Grumman Aerospace Corp., Bethpage, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 153(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43156 ELECTRONIC-SYSTEM HARDENING APPROACHES. Poll, R. A. (Systems, Science and Software, La Jolla, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 100-3(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Many electronic systems have to operate in nuclear environments, and may thus require protection from some or all of the following: electrons, protons, gamma rays, neutrons, x rays, and electromagnetic pulses. The steps to be followed in designing a hardened electronic system are discussed. Hardening approaches appropriate to ionizing radiation (total ionizing dose and prompt ionizing radiation), permanent damage, and EMP effects are described. (2 tables) (R.W.R.)

43157 SYSTEM TO MEASURE SEMICONDUCTOR CHARACTERISTICS OVER DECADES OF TIME AFTER A RADIATION PULSE. Maier, R. J. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 679-81(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The system described generates a set of semiconductor-device driving pulses, logarithmic in time, which are used to display a sequence of characteristic responses on a scope. The system is especially suited for damage-annealing studies following a radiation (neutron, gamma, electron) pulse. The sequence of measurements begins as soon as 50 ns after the beginning of the radiation pulse and can be terminated after milliseconds, seconds, hours, or even a day. This is the only system known which can produce this range of times on a single oscilloscope picture. Representative data from experiments designed to measure the turn-on characteristics of a MOSFET following electron irradiation, the DC gain (h_{FE}) of a 2N2222-A transistor following electron irradiation, and the fast beta annealing of transistors following a 14-MeV neutron burst are given. (6 figures) (auth)

43158 COMPUTER STUDIES OF RADIATION EFFECTS IN AVALANCHE DIODES. Anderson, Wayne A. Rutgers—The State Univ., New Brunswick, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 894-6(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A computer program DIODRAD was written to solve equations for radiation effects in IMPATT diodes. This program permits the user to select integration accuracy, doping profile, and operating conditions in calculating the effects of neutron fluence and gamma flux on diode performance. Results from this work compare favorably with previous theoretical and experimental data. (2 tables) (auth)

43159 NEUTRON IRRADIATION EFFECTS IN LSA OSCILLATORS. Wilson, W. E. (Sandia Labs., Albuquerque, N. Mex.). Proc. IEEE (Inst. Elec. Electron. Eng.); 59: No. 11, 1633-4(Nov 1971).

Four high-peak-power LSA diode oscillators were exposed to high-energy neutron flux in successive steps. Oscillator failure resulted from a decrease in the diode breakdown voltage to the point that breakdown occurred at threshold for fluences of the order of 10^{14} neutrons/cm^2. The reduction in breakdown voltage and an observed frequency increase at a fixed bias can be related to an increase in the diode low-field resistance, which results primarily from neutron-induced carrier removal. (2 figures) (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 42719, 43026, 43111, 43157, 43689, 44310, 44592, 44639, and 44640.

43160 (AECL-4160) STABLE CRYSTAL OSCILLATOR EMPLOYING DIGITAL INTEGRATED CIRCUITRY. Walker, D. A. S. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Mar 1972. 7p. Dep. NTIS (U. S. Sales Only). AECL $0.20.

An inexpensive temperature controlled piezoelectric crystal is interfaced with RTL integrated circuitry to provide pulses at rates of from 1 to 10^6 per second, in decade steps. This facility exhibits a long-term stability of approximately 2 parts in 10^7 per month. (auth)

43161 (RDT-C-2-3-T(6-72)) TIME RESPONSE TEST FOR SHEATHED, MINERAL INSULATED THERMOCOUPLE ASSEMBLY. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1972. 9p. RSO.

A standard is presented that describes a test providing controlled conditions for a reliable and repeatable production check of the response time of sheathed, mineral insulated thermocouple assemblies. (W.H.K.)

43162 ANALYSIS OF THE OPTICAL PROPERTIES OF AN ELECTROSTATIC PARALLEL PLATE SPECTROGRAPH FOR RELATIVISTIC PARTICLES. Bitter, M.; Proca, G. (European Space Research Inst., Rome). Rev. Sci. Instrum.; 43: No. 8, 1125-9(Aug 1972).

The analysis of the optical properties of the electrostatic parallel plate spectrograph is extended to relativistic particles. The conditions for first and second order focusing are derived and a comparison of both types of focusing is given. The second order focusing is found to be superior with respect to intensity and resolution and to offer some other experimental advantages. The analyzer dimensions can be kept small even for high energies. (auth)

43163 MULTIPASSAGE MAGNETIC MASS SPECTROMETER. Fortin, Marc; Baril, Marcel (Univ. Laval, Quebec). Rev. Sci. Instrum.; 43: No. 8, 1140-50(Aug 1972).

A new kind of magnetic mass spectrometer is described. It consists of (n) magnetic prisms integrated into a single pole piece and (n − 1) mirrors which return the beam from one prism to the other. It is shown that by an appropriate choice of the parameters of the apparatus the resolving power increases linearly with the number of passages in the prism. Experimental results verify the theory. Other properties of this system are also discussed. (auth)

43164 ATOMIC OXYGEN BEAM SYSTEM FOR THE INVESTIGATION OF MASS SPECTROMETER RESPONSE IN THE UPPER ATMOSPHERE. Niemann, Hasso B. (Univ. of Michigan, Ann Arbor). Rev. Sci. Instrum.; 43: No. 8, 1151-61(Aug 1972).

An atomic oxygen beam system has been designed and tested for the laboratory evaluation of mass spectrometers used in upper atmospheric measurements. The atomic oxygen is generated by thermal dissociation of molecular oxygen on the surface of a tungsten filament heated to 2800°K. A symmetrical bidirectional beam is produced to permit simultaneous monitoring of the particle flux in the beam while target experiments are being conducted. Flux levels of 5×10^{14} particles cm^{-2} sec^{-1} over a cross-sectional area of 1 cm^2 have been produced with a relative atomic oxygen concentration of 70%. At flux levels below 10^{13} particles cm^{-2} sec^{-1}, relative atomic oxygen concentrations of more than 90% were obtained. The oxygen beam is of high purity and free from chemically active contaminants. Strong chemical and low temperature pumping is used to reduce background gas contributions to less than 1%. Measurements of the relative atomic concentration in the beam were made with a quadrupole spectrometer using an open flowthrough ion source. The absolute flux of molecular oxygen was determined with the aid of an enclosed omegatron mass spectrometer. The combined use of both instruments permitted a determination of the magnitude of the atomic oxygen flux in the beam. (auth)

43165 SIMPLE MODIFICATION FOR OBSERVING A VARIETY OF NUCLEI IN NMR SPECTROSCOPY. Traficante, Daniel D.; Simms, James A. (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instrum.; 43: No. 8, 1122-4(Aug 1972).

A method is described for observing a variety of nuclei in NMR spectroscopy, either in the cw or FT mode. The method basically involves raising or lowering the magnetic field. A simple modification of the lock channel is described that can maintain a field-frequency lock at the new field strength. Thus, at the new field, other nuclei can be resonated with one of the spectrometer transmitters and receivers used for another nucleus. The equipment required is a frequency synthesizer and two rf mixers. The method can be extended to include additional nuclei observed in the FT mode if another rf mixer and a wide-band power amplifier are used. (auth)

43166 HIGH-SPEED MOTION NEUTRON RADIOGRAPHY. Robinson, A. H.; Barton, J. P. (Oregon State Univ., Corvallis). Trans. Amer. Nucl. Soc.; 15: No. 1, 140(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43167 NEW METHOD OF DYNAMIC IMAGING WITH MEDICAL AND INDUSTRIAL APPLICATIONS. Kenney, Edward S.; Jacobs, Alan M. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 15: No. 1, 143-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43168 ON-LINE METER FOR THE MEASUREMENT OF HYDROGEN IN LIQUID SODIUM SYSTEMS. Witkowski, R. E. (Westinghouse Research Labs., Pittsburgh); Berkey, E.; Grundy, B. R. Trans. Amer. Nucl. Soc.; 15: No. 1, 234(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43169 REMOTE MEASURING INSTRUMENTS FOR EXTREME ENVIRONMENTS. Schneider, John C. (Kaman Sciences Corp., Colorado Spring, Colo.). Trans. Amer. Nucl. Soc.; 15: No. 1, 365-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43170 EGU-1 GAMMA-DEVICE FOR DETECTING DEFECTS IN BUILDING MATERIALS. Terekhin, L. N.; Gorin, A. I.; Pavlov, L. S.; Lapshin, S. I.; Shlyak, M. P. Izotopy SSSR; No. 22, 35-6(1971). (In Russian).

The characteristics of a gammascopic installation for variable density evaluations in structural materials and machined parts are briefly outlined. The working range of the installation for mass thickness is up to 90 g/cm^2 with an accuracy of 1 to 1.5%. (tr-auth)

43171 IMPROVED EFFICIENCY OF THE DETECTION OF ^{220}Rn IN AIR. Cardinale, A. (CSN-Casaccia, Rome); Sciocchetti, G.; Wardaszko, T. Minerva Fisiconucl.; 15: No. 4, 156-8(Oct-Dec 1971).

A method for low Rn-220 concentration measurements in air is presented. This method improves and simplifies the measurements by the knowledge of the axial activity distribution in the charcoal bed. Compared to other methods, which require preliminary homogenization of the charcoal of the filter, a 25% count rate increase was noticed at very low temperatures. (auth)

43172 NUCLEAR INSTRUMENTS IN THE FIGHT AGAINST LEAD POISONING. Isotop. Radiat. Technol.; 9: No. 3, 271-7 (Spring 1972).

Two x-ray-fluorescence instruments that use ^{57}Co or ^{109}Cd as the source of exciting radiation for the determination of lead in paint in situ are described. (auth)

43173 INSTRUMENTS AND METHODS FOR CHARACTERIZING RADIOACTIVE AEROSOLS. Raabe, Otto G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 64-75(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The importance of characterizing aerosol properties in evaluating the behavior and potential hazards of radioactive aerosols is emphasized. The instruments and techniques for studying the properties of radioactive aerosols, including special properties such as chemical form, solubility, and state of electrostatic charge, are discussed. The uses of electrostatic and thermal precipitators for electron-microscopic observations and measurements and of various aerodynamic samplers such as impactors, centripeters, cyclones, and aerosol centrifuges for study of size distribution, particle density and shape factors, and relative specific activity are reviewed. The conventional terminology for describing particle size and size distributions is described with emphasis on the relationships to the factors associated with the potential hazards of inhaling radioactive aerosols. (14 figures, 69 references) (auth)

43174 IMPROVED X-RAY INTENSIFYING SCREEN. Buchanan, Robert A. (Lockheed Palo Alto Research Lab., Calif.) IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 81-6(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

It is shown experimentally that a new x-ray phosphor, Gd_2O_2S: Tb, used as an intensifying screen with the common blue-sensitive x-ray photographic film can increase sensitivity to medical x rays by about a factor of 2 relative to $CaWO_4$, which is currently used. It is also shown that a sensitivity increase of about 20 is possible if photographic film is optimized to the Gd_2O_2S: Tb emission. (6 figures, 3 tables) (auth)

43175 LOW-POWER X-RAY DIFFRACTOMETER FOR SOIL ANALYSIS IN REMOTE LOCATIONS EMPLOYING A MULTIWIRE PROPORTIONAL-COUNTER DETECTOR ARRAY. Gregory, J. C. (Univ. of Alabama, Huntsville); Parnell, T. A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 224-32(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A low-power x-ray powder diffraction system suitable for remote mineralogical analysis of lunar, planetary, or asteroid soils was designed. A one-Curie ^{55}Fe source provides a monochromatic 5.9-keV x-ray beam. Seeman—Bohlin or focusing geometry is employed in the camera, this procedure allowing peak detection to proceed simultaneously at all angles and obviating the need for moving parts. The detector system is an array of 500 to 800 proportional counters with a wire spacing of 1 mm. An electronics unit comprising preamplifier, postamplifier, window discriminators, and storage flip-flops requiring only 3.5 milliwatts was designed and tested. Total instrument power is less than 5 watts. Powder diffraction patterns using a flat breadboard multiwire counter were recorded. (14 figures) (auth)

43176 LINEAR DC RESTORER. Semple, Ernest R. (Simtec Industries Ltd., Montreal). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 445-50(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A new concept in nuclear pulse filtering, that of using linear active feedback to accomplish a pulse manipulation, is introduced; until now such manipulation has been performed only by nonlinear methods. The linear method eliminates threshold effects and extends the circuit application to low-level and to highly linear signals, without the inherent increase in noise produced by the nonlinear methods. A linear circuit was constructed which performs the function of dc restoration; that is, pulses which occur randomly in time and have low-frequency components which overlap to produce degradation of primary pulse information may be clarified and separated by the circuit. The action is similar to the basic Robinson restorer except that no threshold or other nonlinearity is involved and no noise need be introduced. The results are otherwise comparable, and time of pulse recovery to 0.01% of signal level may be traded off against reduction of signal amplitude. (9 figures) (auth)

43177 METHODS OF MULTIPLEXING SEVERAL LINEAR SIGNALS INTO ONE ANALOG-TO-DIGITAL CONVERTER. Festa, E.; Hrisoho, A. (Institut de Physique Nucleaire, Orsay, France). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 475-9(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Some practical examples are given for circuits enabling simultaneous conversion of several correlated or noncorrelated parameters with one ADC. The analog memories (stretchers) used as buffers introduce a dispersion due to the nonideal stretcher when noncorrelated parameters are converted. A method of calculation is given to evaluate the dispersion introduced by the circuit. In the case of an important dispersion a symmetrization of the data around the correct value is proposed so that the dispersion is reduced by a factor two. (9 figures) (auth)

43178 CAMAC IN REAL-TIME COMPUTER SYSTEMS. Hooton, I. N.; Lewis, A. (United Kingdom Atomic Energy Authority, Harwell, Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.: NS-19: No. 1, 480-2(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The performance of real-time systems depends on the combination of data acquisition and processing times. Programmed input-output is too slow and data channels are insufficiently flexible for general use with CAMAC. The provision of a separate peripheral processor gives optimum real-time performance. The overall design philosophy and the implications for system software are discussed. (auth)

43179 NIM FAST LOGIC MODULES UTILIZING MECL III INTEGRATED CIRCUITS. Althaus, R. F.; Nagel, L. W. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 520-5(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The design and construction of fast logic modules for nuclear instrumentation has always been a costly and time-consuming effort. The demands for and on modules have increased considerably; greater quantities with improved performance capabilities are needed. Improved performance and reduced module cost are obtained by using commercially available emitter-coupled logic and a minimal amount of interface circuitry to form compatible functional circuits which can then be combined to create the various modules necessary for nuclear instrumentation. This paper describes the operation of several functional circuits that were designed at the Lawrence Berkeley Laboratory to utilize effectively the Motorola MECL III line of integrated logic circuits in NIM Standard fast logic modules. The modules process pulses with rise and fall times of approximately 1 ns and can operate at pulse repetition rates in excess of 300 MHz, yet their cost is less than half that of commercially available 200-MHz units. (11 figures) (auth)

43180 FAST ELECTRONIC MODULES FOR A SUBNANOSECOND COINCIDENCE-ANTICOINCIDENCE LOGIC. Horvath, P. (Joint Inst. for Nuclear Research, Dubna, USSR). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 534-9(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A versatile system of circuits intended to make up modules for a subnanosecond coincidence—anticoincidence logic and a supervisory nanosecond logic is described. The signal resolution of the discriminators is 5 ns; the time resolution of the modules for many-fold coincidence operation is 0.5 ns. The temperature range for reliable module operation is 15 to 55°C. (5 figures) (auth)

43181 PEPPO: A DUAL DIGITAL DELAY AND GATE GENERATOR. Bertolucci, Boris (Stanford Univ., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 540-4(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A high-performance two-channel gate generator in a triple NIM module using integrated circuits is described. Its main characteristics are the digital design and the generation of both delay and width of a signal, relative to a trigger pulse, in each channel. (7 figures) (auth)

43182 DIGITAL RATE METER WITH THE RAPID-RESPONSE SPEED. Polivka, V. (Research Inst. for Nuclear Instrumentation, Premysleni, Czech.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 545-53 (Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A feedback method for digital measurement of the rate of statistically distributed pulses is described. The system adapts automatically to the situation at its input. If great changes of measured quantity are observed, the output follows these changes fast with greater standard deviation; later the first "estimation" of the value of measured quantity is further improved. The basic dynamic properties as well as standard deviation both at transient and steady-state are described and dynamic properties of various methods of digital rate measuring are compared. The described method of rate measuring can be applied also to digital measuring of relative rate n/n_0 or of rate relative difference $(n-n_0)/n_0$. (10 figures) (auth)

43183 QUADRATIC PULSE-HEIGHT ANALYZER FOR SPACE APPLICATIONS. Burtis, D. W. (Time-Zero Corp., Torrance, Calif.); Aalami, D.; Evelyn-Veere, R. H.; Sarkady, A. A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 613-17(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A flight-worthy pulse height analyzer that has a quadratic transfer function is described. This quadratic function permits optimum usage of the entire PHA dynamic range due to the quadratic nature of the resolution vs energy properties of the gamma ray spectrometer. After the theoretical design discussion, the implementation of the design is examined and test results are described. The analyzer is part of the University of New Hampshire Gamma Ray Monitor for OSO-H. (3 figures, 2 tables) (auth)

43184 GENERAL DATA BUS WITH A DUAL MULTIFUNCTION 100-MHz SCALER. Ohlhaber, T. R.; Cloke, R. L. (Dept. of Health, Education, and Welfare, Rockville, Md.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 674-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A bidirectional, 16-bit data bus, which forms an extension of a "mini"-computer I—O bus, was designed, including a controller for the bus, which allows individual control of up to 512 digital devices. One such device, a dual, programmable, 100-MHz, 16-bit scaler was also designed and coupled to the bus. The circuits for the controller, bus, and scaler circuits are constructed of readily available TTL integrated circuits; therefore, this system could be adapted to most small computers. (5 figures, 1 table) (auth)

43185 CAMAC MULTI-MICROPROGRAMMED IO PROCESSOR. Buchanan, James A.; Jones, Hugh V. (Rice Univ., Houston). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 682-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A CAMAC Branch Driver is described which provides multiple-channel direct memory access to a host computer via a single DMA interface. Command lists in computer memory select microprogrammed sequences, stored in a fast-access Control Memory, which transfer data between CAMAC devices and lists in computer memory. (18 figures) (auth)

43186 ALGEN: A MICROPROGRAMMABLE CAMAC BRANCH DRIVER/CONTROLLER. Oakes, Alan E. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 696-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The computer and Branch Driver are the two most expensive devices associated with a typical CAMAC system. A device which was designed to replace both the computer and the Branch Driver of many systems— at less than half the cost—is described. Algen (a contraction of algorithm generator) may also be used with a computer, in which case it serves as a unique Branch Driver which can relieve the computer program of many "housekeeping" duties. (4 figures) (auth)

43187 VERSATILE PDP-11 CAMAC CRATE CONTROLLER FOR NUCLEAR DATA ACQUISITION AND PROCESSING. Halling, H.; Zwoll, K.; Mueller, K. D. (Kernforschunganlage, Juelich, Ger.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 699-703(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A crate system controller was designed with the aim of offering an economical and simple interface between CAMAC Dataway and Unibus of the PDP-11. This unit has the capability of transferring commands as well as 16- or 24-bit data words between the computer and a single module in programmed, increment-to-memory, add-to-memory, and block-transfer modes. An interrupt vector-generator module provides fast LAM handling. In line with the purpose of providing a versatile system, the software for controlling the interface was kept simple and powerful. (4 figures) (auth)

43188 SOME SOFTWARE IMPLICATIONS OF CAMAC INSTRUMENTATION. Lewis, A. (Atomic Energy Research Establishment, Harwell, Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 704-5(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

CAMAC provides an interface through which a computer interacts with its environment. External parameters are represented by hardware registers, which are accessed by the computer in a uniform manner; therefore, explicit I/O coding is unnecessary. The implications of implied I/O on software efficacy in real-time systems are discussed. (auth)

43189 SIMPLE CAMAC SYSTEM. Freytag, Dietrich (Univ. of Massachusetts, Amherst). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 719-20(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A data acquisition system using CAMAC hardware and a very basic set of CAMAC rules is described. With a modest effort and at low cost an approximately 1000-bit system was assembled in a University lab, and is now used in a counter—digital spark chamber system. Simple interfacing modules to multichannel Nixi display, printer, incremental tape unit, and PDP8 and PDP15 computers are described. (auth)

43190 DESIGN OF CAMAC BRANCHDRIVERS. Dhawan, Satish (Yale Univ., New Haven). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 721-5(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

An interface for the CAMAC branch highway to a computer is called a branch driver. The design of a branch driver with various capabilities is studied, and the modular aspects of the design are explored. The design is divided into three sections, namely, computer, branch-highway, and internal. This approach was implemented on the PDP-8 and PDP-15 computers and in the near future it will also be available on the PDP-11. (auth)

43191 NEW THERMOMETRY FOR LIQUID SODIUM. Kuwabara, Jun (Japan Atomic Energy Research Inst., Tokai). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 899-906(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A new thermometry for liquid sodium, which rests on the low resistivity and the moderate thermo-emf of liquid sodium, was developed for the individual subassembly outlet instrumentation in the sodium-cooled fast-breeder reactor, which requires "more reliable and precise information with higher sensitivity at less sacrifice and cost." Unusual thermal-electric combinations of "chromel—sodium—alumel" and "chromel—sodium—chromel" were studied to obtain more information through the same number of sensors and lead wires. Also, a unique combination of "stainless steel—sodium—stainless steel" was tried as the fast-response temperature fluctuation detector, which would make the detection of a few overheated pins in one subassembly possible. The feasibilities for these were preliminarily analyzed. The transient responses were graphically solved by a newly developed method. Some interesting results were obtained. Experiments proceeded on the existing sodium loops, on the simple sodium pot, and on some melting solder baths. No definite objection raises were found. The new thermometry is considered to be feasible and useful, not only as individual subassembly instrumentation, but also as the surface temperature detector, as the temperature fluctuation detectors for transit-time and Karman vortex flowmeters, and as some experimental means for liquid sodium. (11 figures, 1 table) (auth)

43192 LARGE DIAMETER ROTATING LID VACUUM CHAMBER. Schmieder, R. W. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 102: No. 2, 313-15(1972).

A new design for a large diameter rotating lid vacuum chamber is presented which incorporates two innovations: (1) a statically loaded rotating double lid; and (2) a ferromagnetic liquid vacuum seal. These features nearly eliminate the normal friction from atmospheric loading and vacuum seal compression, thus requiring extremely low torque for rotation. The lid on a typical chamber 1 m in diameter with a hard vacuum against 1 atm could be rotated at 0.1 rpm with a torque of about 0.1 inch ounce. Model tests have verified the principles of the design. (auth)

43193 NEW SMALL-ANGLE X-RAY CAMERA WITH TWO GLASS BLOCKS. Schnabel, E.; Hosemann, R.; Roede, B. (Max-Planck-Gesellschaft, Berlin). J. Appl. Phys.; 43: No. 8, 3237-9(Aug 1972).

The x-ray small-angle camera consists of two glass blocks. One of them is used as a monochromator by total reflection, the other shields the plane of observation from background radiation. In connection with a microfocus x-ray tube, this camera offers high intensity and large resolving power. The primary beam is limited only by the width of the microfocus and by the slit between the glass blocks. A comparison was made with the intensity scattered by a Lupolen sample recorded by a Kratky camera with a quartz monochromator and by our camera. If both cameras are adjusted to the same resolving power (1000 Å), the parasitic scattering is the same for both cameras and the intensity of the glass camera is 4.2 times larger. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 44410.

43194 (WRE-TM-494(WR and D)) ISOTOPE SEPARATION USING LASER EXCITATION. Kilpin, D. (Weapons Research Establishment, Salisbury (Australia)). Oct 1971. 14p. Dep. NTIS (U. S. Sales Only).

Laser excitation isotope separation is a feasible proposition because of the existence of isotopically specific absorption features, and the capability of matching their linewidths and positions with laser emission. Much experimental effort will be necessary to establish operable systems for isolation of the excited species. However, the concept of this separation method offers very wide choices of isotopic absorbing species, energies of radiation, reactants, and reaction conditions for economic optimisation of isotope separation. Isotope separation using laser excitation promises to provide many of the natural isotopes at costs many times less than those currently prevailing. The prospect of the heavy isotopes of carbon, nitrogen, and oxygen being available at one tenth or one hundredth of the present prices will enable widespread effective use to be made of them, particularly by chemists for mechanistic and structural studies. The enormous potential of the method to the separation of ^{235}U from natural uranium is obvious, and illustrates how the extraordinary specificity of the method is particularly well suited to the efficient separation of low natural abundance isotopes. (auth)

43195 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1973. PART 4. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETY-SECOND CONGRESS, SECOND SESSION, ON NUCLEAR FUELS; REGULATION, MARCH 7, 8, AND 9, 1972. Washington, D. C.; Joint Committee on Atomic Energy (1972). 933p. GPO $3.75.

Testimony by U.S. Atomic Energy Commission representatives is presented on plans for assuring adequate U enriching capacity to meet needs for nuclear fuel and budget requirements for nuclear regulatory programs during fiscal year 1973. (J.R.D.)

43196 ELECTROCHEMICAL ISOTOPIC SEPARATION PROCESS. Boenemay, Maurice; Bronoel, Guy; Doniat, Denis (to Etat Francais. Delegation Ministerielle pour l'Armement). French Patent 2,077,885. 5 Nov 1971. Filed 23 Feb 1970. (In French).

This isotope separation process consists of utilizing a non-constant potential gradient in a region of the electrolyte near to the electrode. The potential gradient is produced by positioning an assembly of microporous membranes (in such a way that the ohmic drop is not proportional to its thickness) between the core of the electrolyte and the electrode. The electrolytic solution in the space between the exit face of the assembly and the electrode becomes enriched in light isotopic elements. Initially the membranes, and the electrolyte between these membranes and the electrode are depleted in the isotopic species to be separated. An application is cited in which a ^{235}U enriched product is obtained from a U compound containing different isotopes in their natural abundances. (France)

43197 USE OF THE CRITICAL STATE FOR ISOTOPE SEPARATION. Berestov, A. T.; Malyshenko, S. P. At. Energ. (USSR); 32: No. 5, 424-6(May 1972). (In Russian).

The hydrostatic effect in mixtures of isotopes was examined with a view to exploiting it in isotope separation. The hydrostatic effect with respect to concentration in common mixtures was significantly greater than in isotope mixtures. It was concluded that more definite conclusions regarding the use of the hydrostatic effect must await experimental results. (K.S.W.)

43198 DETERMINATION OF OPTIMUM FLOW RATE OF HEAVY WATER DURING THE DEUTERATION OF THE ION EXCHANGERS OF THE ZEROLIT TYPE. Kysela, Jan; Vagner, Jaroslav (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 18: No. 6, 183-5(Jun 1972).

The amount of heavy water which is deteriorated by isotopic exchange with light water during deuteration of ion exchangers depends on the flow rate of heavy water through the ion exchange column and mutual interdiffusion. In a model experiment an optimum linear velocity of 0.068 cm/min was found for heavy water passing through the column which will be used in the purification unit of the TR-0 Reactor. The amount of deteriorated heavy water is equal approximately to 8.5% of the total volume of ion exchanger charge for this linear flow velocity if resins of Zerolit-type are used. (auth)

Isotopic Power Sources

Refer also to abstracts 42861, 42873, 43405, and 43543.

43199 (ORNL-TM-3805) ISOTOPE KILOWATT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1972. Fraas, A. P.; Samuels, G. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 22p. Dep. NTIS.

The organic fluid capsule test continued through the quarter without incident. The total operating time at the end of March was 10,685 h, of which 3600 h has been accumulated since replacement of four capsules in November. The final results of the chemical analysis of the four capsules removed after 7000 h show very little decomposition or gas evolution and are very close to those predicted in the organic Rankine cycle reference report (ORNL-TM-2960). Construction of the quarter-scale organic fluid decomposition test loop is nearly completed. The major problem now looming is procurement of sufficiently high purity Dowtherm A. The best sample submitted by Dow Chemical appears to have 300 ppM of an unknown impurity which might conceivably be a fluorocarbon. Efforts to resolve this problem are underway. The thermoelectric module test continued until March 19 at which time a total of 4989 h of continuous operation had been accumulated. The unit was shut down to permit repair of an argon leak that developed over a period of several months. This was in the instrument header and increased to the point where repressurization was required every few days. The repair will be done with epoxy resin supplied by 3M. The twelve heat pipes for use in the heat block-shield test have been charged with potassium, and will be thoroughly outgassed in a vacuum furnace. The thermal conductivity tests on the $\frac{1}{4}$-scale heat block thermal insulation rig were completed. The results showed a somewhat higher thermal conductivity at higher temperatures than the earlier data. The meltdown test using the quarter-scale heat block test rig was carried out to determine the meltdown characteristics of the alternate foil-aluminum screen thermal insulation. The peak temperature reached in the test was 1514°F after 9.92 h of operation. Inspection of the melted material after the test indicated that even with the nitrogen gas rather than air in the evacuated vessel there was sufficient oxide formation to inhibit the meltdown of both the screen and the foil. Tests of the full-scale heat block-shield temperature distribution have been completed. The results agree closely with those predicted analytically. A topical report covering the entire task has been drafted. Typing of this rough draft report should be completed early in April, and should be issued within a few weeks of this quarterly report. As a consequence of FY 1973 budget considerations in Washington, work on the full-scale organic Rankine cycle system was terminated. The design work was largely completed and procurement had been initiated, but no firm orders had been placed. (auth)

43200 (ORNL-TM-3865) ISOTOPIC POWER MATERIALS DEVELOPMENT PROGRESS REPORT FOR MAY 1972. Donnelly, R. G. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 14p. Dep. NTIS.

Research on cladding materials was directed to properties of Pt-Rh-W alloys, properties of Ir, and Ir purification. Refractory alloy investigations were conducted on Mo-base alloys. Other research is reported on compatibility of LASL-DART materials. (J.R.D.)

43201 ADVANCED HEAT SOURCE CONCEPTS. Selle, J. E. (Monsanto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc.; 15: No. 1, 160-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43202 MULTI-HUNDRED-WATT HEAT SOURCE TECHNOLOGY. I. FABRICATION DEVELOPMENT AND COMPATIBILITY TESTING. Mulford, R. N. R.; Keenan, T. K.; Nutt, A. W.; (and others) (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 161(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43203 MULTI-HUNDRED-WATT HEAT SOURCE TECHNOLOGY. II. Johnson, E. W. (Monsanto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc.; 15: No. 1, 161-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43204 MHW HEAT SOURCE: AN ADVANCE IN RADIOISOTOPE HEAT SOURCE TECHNOLOGY FOR SPACE APPLICATIONS. Notestein, John E. (General Electric Co., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 1, 163(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43205 QUALITY PROGRAM FOR SPACE-RELATED HEAT SOURCES. Ember, William N. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 164 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43206 SAFETY OBJECTIVES OF HEAT SOURCE TECHNOLOGY. Goldenberg, Neal (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 164-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43207 RADIOISOTOPE HEAT SOURCE FOR ARTIFICIAL HEART HEAT ENGINES. Watrous, J. D.; Smith, T. H.; Greenborg, J.; Andelin, R. L. (Donald W. Douglas Labs., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 165-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43208 GEOMETRY COMPARISONS FOR WEIGHT AND SAFETY OF MULTIWATT RADIOISOTOPE HEATERS. Smith, T. H.; Barsell, A. W. (McDonnell Douglas Astronautics Co., Richland, Wash.). Nucl. Eng. Des.; 21: No. 3, 435-45(1972).

Potential advantages of radioisotopes over other energy sources for aerospace applications depend greatly on isotope design efficiency. To determine an optimum configuration for a family of small multipurpose ^{147}Pm and ^{238}Pu fueled heaters, design and safety tradeoffs were made for spherical and various cylindrical fuel capsules individually protected by graphite ablators of various geometries. Primary design constraints were intact reentry and helium pressure containment at peak reentry temperatures for a long rated life. The spherical configuration was optimum for weight, helium pressure containment, and impact survival. Design penalties for cylindrical capsule geometries, including different L/D ratios and end shapes, were analyzed. For the reentry heat shield, a cubic shape is optimum for aeroheating, thermal response, impact velocity, and system integration. The spherical capsule/cubic ablator configuration is recommended for design consideration. (auth)

Radiation Sources

Refer also to abstracts 42901, 42969, 43405, 43632, 44939, and 44940.

43209 (INR-P-1363) METROLOGICAL METHODS OF RADIONUCLIDES. Lada, W.; Jablonska, J.; Pochwalski, K.; Radoszewski, T. (Institute of Nuclear Research, Warsaw (Poland)). 1971. 35p. (CONF-700540-9). Dep. NTIS (U. S. Sales Only).

From Polish-Italian seminar on some chemical, ceramic, and metallurgical aspects of nuclear fuels; Zakopane, Poland (29 May 1970).

The metrological methods related to the use of radionuclides are presented. They include both the methods for activity measurements, and the methods for controlling the radiation purity of radioisotopes. The methods investigated could be divided into several groups, according to the type of radiation emitted by the radioisotope to be measured, namely: methods for pure β-emitters; methods for $\beta-\gamma$-emitters; methods for electron–capture nuclides; and methods for α-emitters. The next criterion, which is taken into account in the methods investigated, is the physical form of the radioactive substance, as some of the methods could be used only for open sources, and the other only for sealed sources. (auth)

43210 INTENSIFICATION OF FADED PHOTOGRAPHS AND UNDEREXPOSED NEGATIVES USING RADIOISOTOPES. Thackray, M.; Roman, D. (Australian Atomic Energy Commission, Coogee). At. Energy Aust.; 15: No. 2, 24-30(Apr 1972).

Faint images on negatives or images on old faded prints are radioactivated and exact copies of the active photograph are made by pressing it against unexposed film. Any desired density may be obtained by varying the contact time. The image can be radioactivated by thermal neutrons, by "toning" with radioactive elements, by exchange reactions in which the photograph is treated with a solution in which a radioactive silver isotope is dissolved, or by combinations of these. Carrier free isotopes such as ^{35}S or ^{210}Po that have a strong affinity for Ag can produce dense autoradiographs with an overnight exposure when the surface concentration is as low as 10^{-13} g/cm^2. Artificial Ag patterns on inert surfaces can thus be autoradiographed at almost this level. However, normal photographs, even when developed without any exposure, usually produce fog levels greater than 10^{-5} g/cm^2 Ag and no image of lower density can be recognized or intensified. Some applications are discussed. (Australia)

43211 USE OF BETA RADIATION TO MEASURE THE TEMPERATURE OF A HOT GAS FLOW OR FLAME. Gavrilov, F. V.; Merkulov, V. S. Meas. Tech. (USSR) (Engl. Transl.); 14: No. 12, 1865-7(Dec 1971).

Translated from Izmer. Tekh.; 14: No. 12, 51-2(Dec 1971).

A radioisotope method for studying hot gas flows and for determining the temperature in a laminar planar flame based on measurement of gas density is described. The straightforward relation between the gas flame temperature, ambient temperature, and the relative medium density, i.e., the ratio of flame gas density to ambient gas density, is derived from the equation of state. Since the relative medium density can be determined directly by measuring the attenuation of a beta beam passing through the flame, this measurement can be converted to flame temperature readings when the ambient temperature is known. The experimental equipment and method used for measuring the maximum flame temperature and the temperature distribution along the vertical axis of the flame are described. The beta source was 5 mCi of #3 phosphor. The results were in good agreement with theoretical predictions. It is concluded that the radioisotope method for monitoring the temperature of gases and high-velocity gas flows may be particularly useful for studying combustion and other physicochemical processes which arise in gas dynamics, vacuum technology, chemistry and other fields. (L.C.L.)

43212 PERSPECTIVE: REGULATION OF RADIOPHARMACEUTICALS. Veerling, J. Peter Jr.; Glenn, Howard J. (Univ. of Texas, Houston). Trans. Amer. Nucl. Soc.; 15: No. 1, 132(Jun 1972).

From eighteenth annual American Nuclear Society conference, Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43213 RECENT REVISIONS OF THE REGULATIONS FOR RADIOPHARMACEUTICALS. Meyers, Earl L. (Food and Drug Administration, Arlington, Va.). Trans. Amer. Nucl. Soc.; 15: No. 1, 134-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43214 INDs AND NDAs FOR RADIOPHARMACEUTICALS. Meyers, Earl L. (Food and Drug Administration, Arlington, Va.). Trans. Amer. Nucl. Soc.; 15: No. 1, 135(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43215 PRODUCTION AND MEASUREMENT OF A REFERENCE SPECTRUM IN A VERSATILE EXPERIMENTAL FACILITY. Draper, E. L. Jr.; Chromik, J. J. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 15: No. 1, 157(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43216 IMPROVED FORM FOR ^{252}Cf NEUTRON SOURCES: PALLADIUM–^{252}Cf OXIDE CERMET. Mosley, W. C.; Smith, P. K.; McBeath, P. E. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 228-9(Jun 1972).

From eighteenth annual American Nuclear Society conference Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43217 RESEARCHES CONCERNING THE ASCERTAINMENT OF DEFECTS ON ROLLED IRONS THROUGH RADIO ISOTOPES. Guerrieri, A.; Maganzi, S. Met. Ital.; 63: No. 12, 605-12(Dec 1971). (In Italian).

Results of studies are presented directed to evaluating the quality of present rolling schemes and determining the coefficients of reduction of surface defects (flaws) on semi-finished products as a function of different forging ratios. These studies were conducted from the point of view of statistics, through discussions of the conditioning of semi finished products, and results of the final inspection of finished products. These methods cannot be used to explain the transformations of defects for the different cases. Solutions that have been adopted to offer complementary information are shown. (auth)

43218 OSNOVY PRIMENENIYA IONIZIRUYUSHCHIKH IZLUCHENIYA V AVTOMATIKE. (Principles Pertaining to the Use of Ionizing Radiation in Automation). Portnoi, Yu. V. Moscow; Atomizdat (1969). 168p.

The first half of this book consists of an elementary presentation of the concept of ionizing radiation, isotopes, radioactive conversion, and the fundamentals of dosimetry and radiation protection. The second half focuses attention on measuring and control techniques e.g., thickness, level, and density gages, moisture meters, analyzers of composition and concentration, relay devices, regulators, signaling, and various automation schemes, based upon the use of radioisotopes and nuclear radiation. (29 references) (K.S.W.)

43219 DIFFUSION OF CHLORINE ION BY RADIO-TRACER TECHNIQUE. Sahu, T.; Mishra, I. S.; Khalsa, S. P. S.; Das, S. K. (Fertilizer Corp. of India Ltd., Sindri). Technology (Sindri); 8: No. 2, 171-3(1971).

Results of diffusion studies using ^{36}Cl contained in HCl are presented. Specimens of black synthetic enamel paints were tested for film diffusion resistance by exposure to the labeled HCl. Results are presented graphically and discussed. (J.R.D.)

Design and Fabrication

43220 (RD/B/N–2258) LOW GAMMA BACKGROUND THERMAL NEUTRON STACK. Longworth, J. P.; Tobias, A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Mar 1972. 31p. Dep. NTIS (U. S. Sales Only).

Preliminary water tank experiments and the design of a polythene low gamma background thermal neutron stack are described. The calibration of the facility is also given. The sub-cadmium neutron flux density was measured by gold foil activation and LiF extruded rods; maximum values were 6.75×10^3 n/cm^{-2}/s^{-1} and 7.20×10^3 n/cm^{-2}/s^{-1} at 2.1 and 2.3 cm respectively from the surface of the lead sphere containing the source. At 2.3 cm the gamma exposure rate is 11.8 mRh^{-1}, and the cadmium ratio is 51 : 5. An important feature of the facility is the large variation of the neutron/gamma ratio with distance from the lead sphere. (auth)

Industrial Uses

Refer also to abstract 43226.

43221 PROCESS FOR IMPROVING THE YIELD OF WATER EXTRACTABLE SOLIDS OBTAINABLE FROM TEA. (to Hindustan Lever Ltd.). Indian Patent 108,855. 27 Jun 1969.

A process for improving the yield of water extractable solids obtainable from tea is described. The method comprises exposing manufactured tea to an effective dose of ionizing radiation which is sufficient to improve the yield of water-extractable solids. (auth) (Indian Sci. Abstr.)

43222 FORD ELECTROCURE PROCESS. Hulce, R. A. (Ford Motor Co., Dearborn, Mich.). Trans. Amer. Nucl. Soc.; 15: No. 1, 167-8(Jun 1972).

From eighteenth annual American Nuclear Society conference, Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43223 ELECTRON BEAM IRRADIATION PROCESS FOR THE PULP AND PAPER INDUSTRY: THE IRRADIATION OF WOOD CHIPS. Free, D. (Radiation Development Co., Ltd., Vancouver, B. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 168(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43224 ELECTRON PROCESSING BECOMES ANOTHER PRODUCTION TOOL. Hoffman, C. R.; Gantt, E. D. (High Voltage Engineering Corp., Burlington, Mass.). Trans. Amer. Nucl. Soc.; 15: No. 1, 176(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

LIFE SCIENCES

43225 ISOTOPES AND RADIATION IN BIOLOGY. Thornburn, C. C. London: Butterworths (1972). 293p. Pound 3.50.

The following aspects of the subject are considered; physical aspects of radiation, the detection and measurement of ionizing radiation, the usage of isotopes, the uses of ionizing radiation, health physics, the effects of ionizing radiations on living organisms, and radioactivity in the biosphere. Some suggestions for practical work are given. (UK)

Radiation Effects on Biochemicals (External Source)

Refer also to abstracts 42784 and 43322

43226 (EUR-4695) IDENTIFICATION OF IRRADIATED FOODSTUFFS. Proceedings of a Colloquium, Luxembourg, October 27, 1970. Smeets, J. (ed.) (European Communities, Luxembourg. Commission). 170p. (In several languages). (CONF-701068).

Separate abstracts were prepared for the 13 papers presented in these proceedings. The papers discuss the various analytical methods used in the identification of irradiated foods. (E.R.B.)

For abstracts of individual papers see: 42759, and 43227–43238.

43227 (EUR-4695, pp 13-26) CONDUCTIVITY MEASUREMENT AS A METHOD FOR DIFFERENTIATION BETWEEN IRRADIATED AND NON-IRRADIATED POTATOES. Progress Report, April 1, 1967–October 1, 1970. Scherz, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

Irradiation causes a decrease in the electrical conductivity of potato tubers. The difference in the conductivity value measured immediately after puncturing the tuber with the electrodes and that measured up to 180 sec later ($\Delta_t - \Delta_{t(180)}$) decreases with increasing irradiation dose, regardless of potato variety. It appears that this difference value can be used to differentiate between potatoes irradiated with low doses (0 to 20 krad) and those irradiated with high doses (20 to 100 krad). Storage does not influence conductivity as long as the tubers remain unsprouted. On sprouting, both the absolute conductivity and the conductivity difference decreases. (auth)

43228 (EUR-4695, pp 27-36) EVALUATION OF THE STRUCTURE OF THE DEOXYCOMPOUNDS FOUND IN IRRADIATED STARCH AND DETERMINATION OF THESE PRODUCTS IN IRRADIATED WHEAT AND WHEAT FLOUR. Progress Report, February 1, 1968–October 1, 1970. Scherz, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

Malondialdehyde and deoxycompounds are formed on irradiation of carbohydrates. Irradiated potato starch, wheat flour, and wheat grain were extracted with a mixture of ethylacetate-acetone-water after lipid removal. The deoxycompounds present in the extract were separated by paper chromatography and detected with the periodic acid-thiobarbituric acid reaction. By visual comparison of spot size and spot intensity, a semi-quantitative determination of the applied dose range was possible. The lower limit at detection was between 100 and 200 krad. For a better quantitative estimation, gas-chromatography following silylation was employed. By reduction with potassium boronhydride, a distinct difference in the pattern of irradiated and untreated material was observed. The combination gas-chromatography and mass spectroscopy was used to identify some of the radiolytic products. Direct colorimetric estimation at deoxycompounds in extracts of irradiated wheat flour was unsuccessful. Direct colorimetry of malondialdehyde was possible, but due to the instability of this compound, especially in presence of proteins, unsuitable for identification. (auth)

43229 (EUR-4695, pp 37-58) IDENTIFICATION OF IRRADIATED MEAT BY THIN-LAYER GEL CHROMATOGRAPHY AND SOLUBILITY STUDIES. Progress Report, April 1, 1967–October 1, 1970. Radola, B. J. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

In beef and pork irradiated with a dose of 1 and 5 Mrad, a new radiation-induced, sarcoplasmic protein fraction was observed on thin-layer gel chromatography on Sephadex G-200. Due to its high R_M value, the radiation-induced fraction migrating ahead of all other sarcoplasmic protein fractions of untreated meat could be easily identified in the chromatographic pattern. Irradiation experiments with isolated sacroplasmic proteins strongly suggest that the radiation-induced fraction results from aggregation of these proteins. The amount of the radiation-induced fraction increased with increasing dose. Irradiation temperature and dose rate were found to affect the formation of the radiation-induced fraction. Storage of meat irradiated with 5 Mrad at room temperature for periods up to 10 weeks has shown that the radiation-induced fraction is stable. Solubility studies based on stepwise extraction of a protein precipitate absorbed on an inert carrier with a series of ammonium sulphate solutions of decreasing molarity have shown that the fractions extracted with 1, 1.5, and 2 M ammonium sulphate are reduced in irradiated meat. The demonstration of the radiation-induced, sacroplasmic protein fraction can serve as a basis for identification of meat irradiated with 5 Mrad. The method is relatively simple and suitable for routine analysis. (auth)

43230 (EUR-4695, pp 59-66) GAS CHROMATOGRAPHIC–MASS SPECTROMETRIC INVESTIGATION OF IRRADIATED ANIMAL FATS. Progress Report, July 1, 1969–October 1, 1970. Drawert, F. (Technische Univ., Munich); Tressel, R.; Beck, B. (In German and English).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

In animal lipids (pork, beef) irradiated with a dose of 6 Mrad, about 60 hydrocarbons, ketons, and alcohols as well as about 30 free fatty acids were detected by gas chromatography and subsequently identified by mass spectrometry. Most of these components do not occur at all or only in trace amounts in the unirradiated material. Isolation and identification of some of the compounds by the combination gas chromatography and mass spectrometry will provide a basis for identification of irradiated lipid-containing material by a simplified procedure. Irradiated fruits can be identified by gas chromatography of aromatic substances. (auth)

43231 (EUR-4695, pp 67-72) IDENTIFICATION OF IRRADIATED POTATOES BY LACK OF WOUND PERIDERM FORMATION. Progress Report, October 1, 1969–October 1, 1970. Penner, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

Irradiated potatoes can be identified histologically. After irradiation, the potato tissue loses its ability for wound periderm formation. Chemical treatment (CIPC-Chlorisopropylphenylcarbaminate) does not inhibit wound healing so that chemically-treated potatoes can be discerned from irradiated ones. The described wound-healing method being a negative one, it is necessary to exclude all wound-periderm inhibiting factors other than irradiation. Above 10 krad, no estimation of the applied dose is possible. (auth)

43232 (EUR-4695, pp 73-83) THIN-LAYER ISOELECTRIC FOCUSING OF SARCOPLASMIC PROTEINS FROM IRRADIATED MEAT. Progress Report, September 1, 1969–October 1, 1970. Radola, B. J. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

Thin-layer isoelectric focusing was used to study radiation-induced changes of the charge properties of proteins. A strong decrease of the most basic proteins and some components present in the middle part of the focusing pattern was consistently observed in meat irradiated with doses of 1 and 5 Mrad. In addition, similar effects were observed for the peroxidase isoenzymes of meat. Isoelectric focusing offers a further criterion for identification on the basis of radiation-induced changes of the charge properties of proteins and enzymes. The combined use of two identification methods based on independent molecular parameters may be anticipated to yield more reliable results than application of a single method. (auth)

43233 (EUR-4695, pp 97-103) VERTICAL STARCH GEL ELECTROPHORESIS AND IMMUNOELECTROPHORESIS OF IRRADIATED AND NON-IRRADIATED ANIMAL PROTEINS. Progress Report, April 1969–April 1970. Bugyaki, L.; van der

Stichelen Rogier, M. (Institut d'Hygiene et d'Epidemiologie, Brussels).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

The first method does not enable fresh codfish to be distinguished from irradiated cod. Conversely, the differences between the electrophoretic pattern from the non-irradiated meat and egg or that irradiated at room temperature are important enough to enable the treated and nontreated samples to be differentiated. The finding to the effect that the difference does not seem to be as important if the irradiation is carried out at low temperature indicates that investigations must be undertaken in this field. In spite of the improvement of the separating power of the electrophoresis and of the precipitating ability of the immune serums, the results of our research do not enable us to differentiate the irradiated and non irradiated meat, fish, and eggs. We therefore see no point in pursuing our research with immunoelectrophoresis. (auth)

43234 (EUR–4695, pp 105-17) IDENTIFICATION OF IRRADIATED WHEAT FLOUR, IRRADIATED POTATOES, AND IRRADIATED EGGS. Progress Report, October 1, 1967–October 1, 1970. Deschreider, A. (Ministere des Affaires Economiques, Brussels. CENATRA, Antwerp).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

Spectrophotometry in uv cannot be helpful for the detection of the irradiation of wheat, wheat flour, eggs, and potatoes, but perhaps in the case of meat and fish. It seems that spectrophotometry in IR gives encouraging results in the field of irradiated eggs. Spectropolarimetry can be used for the detection of the irradiation of wheat and wheat flour. The technique is also useful in the case of irradiated potatoes and eggs. A modification of the method to improve its sensitivity is under study. Turbidimetry is useful for the detection of irradiated wheat and wheat flour, but we try to improve its sensitivity. In the case of irradiated eggs and potatoes, no positive results were obtained. In this investigation, covering a period of 3 yrs, the application of spectropolarimetry, spectrophotometry, turbidimetry, and thermodifferential analysis to the analysis of irradiated foodstuffs was studied. Because the modifications observed in irradiated wheat flour were already published, these results are here summarized and we will develop those obtained for irradiated potatoes and eggs. (auth)

43235 (EUR–4695, pp 119-27) CHANGES IN IRRADIATED FOOD PRODUCTS MEASURABLE BY DIFFERENTIAL THERMAL ANALYSIS. Progress Reports, April 1, 1969–April 1, 1970 and April 1, 1970–October 1, 1970. Maes, E. (Ministere des Affaires Economiques, Brussels. CENATRA, Antwerp).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

A marked decrease can be observed in the peak area in function of the irradiation dose for eggs. The work will be carried out on irradiated wheat and wheat products and also on eggs, in order to confirm the preliminary results obtained. (auth)

43236 (EUR–4695, pp 131-9) PURIFICATION OF INDUSTRIAL STARCH BY IRRADIATION: BIOCHEMICAL CHARGES AND IRRADIATION TEST. Saint-Lebe, L.; Berger, G. (CEN, Cadarache, France). (In French and English).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

Radiolysis products are identified and titrated with a view to supplementing and elucidating studies on the toxicological evaluation of irradiated starch, the subjects being microorganisms and higher animals. At the moment, the only substances certainly identified are malonic aldehyde, formic aldehyde, and hydrogen peroxide. The formation of malonic aldehyde is specific to the irradiation of starch, its titration forming the basis of a test that makes it possible to determine the dose absorbed to ±30 krad, provided the humidity of the sample, the date of irradiation, and the storage temperature are known. (auth)

43237 (EUR–4695, pp 141-8) EVOLUTION OF WEIGHT LOSS DURING PRESERVATION: APPROACH FOR IDENTIFICATION OF IRRADIATED FRUITS. Magaudda, G. (CNEN, Rome). (In French and English).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

A promising method of identification of irradiated fruit (tomatoes and oranges) appears to be provided by the determination of the weight loss during storage. It seems to be a constant and reproducible phenomenon for irradiated fruit to lose more weight than the control. By calculating this time-dependent difference by means of the regression line interpolating the experimental points and comparing the latter with the relative angular coefficient b, it can be shown that this phenomenon is a function of the dose absorbed. (auth)

43238 (EUR–4695, pp 149-57) DEMONSTRATION OF THE EXISTENCE OF MALONALDEHYDE IN SOLUTIONS OF CARBOHYDRATES IRRADIATED WITH GAMMA RADIATION. Morre, J. (Laboratoire de Radiobiologie, Paris). (In French).

From The identification of irradiated foodstuffs conference; Luxembourg (27 Oct 1970).

It is pointed out that the uv absorption pattern of sugars that were gamma-irradiated in medium buffered at pH 9.5 is due to malonaldehyde. The coloring formed with this dialdehyde is isolated by means of a reaction with thiobarbituric acid; it is identified by means of a characteristic spectrum (maximum 535 nm with a shoulder between 480 and 520 nm) and by means of chromatography on silicagel (butanol, methanol, water, sodium hydroxide: 37, 37, 20 cm^3 and 0.50 gr or butanol, methanol, water, acetic acid: 37, 37, 20.5 cm^3. (auth)

43239 (KR–146, pp 56-7) IMMOBILIZATION: A FACTOR MODIFYING INDIRECT RADIATION ACTION ON PROTEINS IN HETEROGENEOUS SYSTEMS. Kasche, Volker (Uppsala Univ. (Sweden). Gustaf Werner Inst.).

From third Nordic Society for Radiation Research and Radiation Technology meeting; Gausdal, Norway (5 Mar 1972).

In heterogeneous systems containing both mobile and immobile molecules of different molecular weight, the radiosensitivity may be influenced by other factors than in the case of homogeneous solutions. Such factors have been studied for indirect radiation action in, firstly, free chymotrypsin (CT) and CT immobilized in 4% Sepharose particles (CT-Sepharose) and, secondly, CT-Sepharose. It is concluded that in heterogeneous systems with mobile and immobile solutes the primary radicals, formed from the solvent in indirect radiation action, react primarily with the mobile species. The number of the secondary radicals, formed in these reactions, which react with immobilized molecules, depends on their diffusion coefficient; also the average activity change per indirect radiation-induced modification may differ for the free and immobilized molecule. (Norway)

43240 (KR–146, pp 59-61) ENZYMATIC CHANGES IN IRRADIATED FISH DURING STORAGE AT 0^{0}C. Jebsen, J. W. (Fiskeridirektoratets Kjemisk-Tekniske Forskningsinstitutt, Bergen (Norway)); Lunde, G.; Underdal, B.

From third Nordic Society for Radiation Research and Radiation Technology meeting; Gausdal, Norway (5 Mar 1972).

Absolutely fresh prerigor cod were gamma-irradiated in a nitrogen atmosphere in gas-tight plastic bags, at levels of 186, 93, 50, and 25 krad. The proteolytic activity in these fish was very low and higher values in the literature probably arise from bacteriological contamination. It may also be a peculiarity of gadoid fish. Other indications of deterioration were also much reduced, and there was no correspondence between bacterial load and proteolytic activity. The risk of irradiation resistant Clostridium botulinum and its toxin in cold storage of irradiated cod seems exaggerated. The low proteolytic activity and low content of trimethylamine and formaldehyde are probably the reasons for irradiated cod lacking fish taste. The storage life of unirradiated fish and fish irradiated with 25 krad was 14 days, while for fish irradiated with 50 and 100 krad this limit was reached a week or more later. (Norway)

43241 (KR–146, pp 63-6) REACTION BETWEEN THE HYDRATED ELECTRON AND DNA IN ANOXIC AQUEOUS SOLUTION. Wold, Einar; Brustad, Tor (Norsk Hydro's Inst. for Cancer Research, Oslo).

From third Nordic Society for Radiation Research and Radiation Technology meeting; Gausdal, Norway (5 Mar 1972).

DNA is assumed to be the most important target for lethal damage in a cell after irradiation. The cell content is an aqueous solution, and irradiation leads to the formation of H and OH radicals and hydrated electrons that can attack the DNA molecule causing lethal damage. OH attack is assumed the most important but the role of the hydrated electron is not completely understood, and was therefore studied by observing its lifetime in anoxic aqueous solutions of DNA. The pulsed radiolysis technique was utilized, using the optical absorption in the region 500 to 750 rm as a measure of the electron concentration. The investigation demonstrated that the hydrated electrons will hardly react with DNA in a biological system, and the hydrated electron is of slight importance as a source of radiation-induced damage in cellular DNA. (Norway)

43242 RADIATION DAMAGE IN LIVING ORGANISMS: INITIAL CHEMICAL CHANGES AND THEIR MODIFICATION. Myers, Lawrence S. Jr. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 15: No. 1, 449(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43243 SPLITTING OF THYMINE DIMER BY HYDRATED ELECTRONS. Santus, R.; Helene, C.; Ovadia, J.; Grossweiner.

L. I. (Michael Reese Hospital, Chicago). Photochem. Photobiol.; 16: No. 1, 65-7(Jul 1972).

The reactivity of solvated electrons (from a pulse radiolysis source) with cis-synthymine dimer was determined from the decrease of the electron lifetime with increasing dimer concentration, as measured from the e^-_{aq} absorbance at 650 nm. The results showed that solvated electrons split thymine dimer, the high yield indicating that monomerization was the predominant process. (UK)

43244 EFFECT OF X-RAYS AND MOLYBDENUM AND THEIR JOINT USE ON THE CONTENT OF ASCORBIC ACID AND THE ACTIVITY OF CATALASE IN THE HARICOT-BEAN. Tsereteli, Ts. G. Soobshch. Akad. Nauk Gruz. SSR; 67: No. 1, 173-6(Jul 1972). (In Georgian).

Pre-sowing treatment of haricot-bean seeds (Tsanava-3 and Saparke-75) with molybdenum and x rays affects the metabolism in experimental plants. The data obtained indicate that such treatment of the seeds leads to an increase in the content of ascorbic acid and in the activity of catalase in the beans and unripe (green) seeds of the haricot-bean. (auth)

43245 NANOSECOND IRRADIATION STUDIES OF BIOLOGICAL MOLECULES. I. COENZYME Q 6 (UBIQUINONE-30). Bensasson, R.; Chachaty, C.; Land, E. J.; Salet, C. (Paris Univ., Orsay, France). Photochem. Photobiol.; 16: No. 1, 27-37(Jul 1972).

The coenzyme ubiquinone, an isoprenoid benzoquinone present in the electron-transport chain of mitochondria, was studied using nanosecond laser flash photolysis and pulse radiolysis. The hitherto undetected triplet excited state of the coenzyme was identified and some of the physico-chemical properties determined. Laser photolysis of ubiquinone in cyclohexane and pulse radiolysis of ubiquinone in benzene resulted in the formation of a transient absorption with maximum around 440 nm and a half-life of 650 nsec in cyclohexane and 450 nsec in benzene. Energy transfer sensitization of the β-carotene triplet absorption by ubiquinone in cyclohexane at a rate consistent with the life-time of the 440 nm transient absorption yielded strong evidence that this transient species was triplet ubiquinone. The triplet reacted with oxygen with a rate constant of 2×10^9 mole^{-1} sec^{-1}. Photolysis studies of ubiquinone in ethanol and isopropanol and addition of ethanol to ubiquinone in cyclohexane showed that little ubisemiquinone is formed by reaction of the triplet with alcohols. Electron spin resonance studies supported this conclusion, and also showed that some ubisemiquinone was however formed on photolysis of solutions of ubiquinone in methylcyclohexane. Energy transfer experiments in the presence of various triplet energy donors and acceptors suggested that the triplet energy of ubiquinone lies between 176 and 123 kJ mole^{-1}, and that the triplet extinction coefficient at 440 nm is 19,000 mole^{-1} cm^{-1} in cyclohexane and 13,000 mole^{-1} cm^{-1} in benzene (at 430 nm). The singlet to triplet crossover efficiency for ubiquinone in cyclohexane was estimated to be 0.04. It is suggested that the low triplet energy level, crossover efficiency, and abnormal type of reaction with alcohols are reflections of the influence of the isoprenoid chain upon excited states of this quinone. (auth)

43246 EFFECT OF X-RAYS ON THE REGULATORY FUNCTIONS OF GLUTAMATE DEHYDROGENASE FROM BEEF LIVER. Sanner, Tore; Pihl, Alexander (Norwegian Radium Hospital, Oslo). Radiat. Res.; 51: No. 1, 155-66(Jul 1972).

Glutamate dehydrogenase from beef liver was irradiated with x rays in solution in the presence of air. The ability of the enzyme to catalyze the oxidative deamination of glutamate and the reductive amination of pyruvate was inactivated with the same yield (G = 0.3 per protomer). The radiation inactivation of the modifying effects of ADP, GTP, sodium chloride, sulfhydryl blocking, and substrate inhibition was measured. When assayed with glutamate as substrate, the different allosteric functions had the same or higher radiosensitivity than the catalytic activity. The most radiosensitive function was the substrate inhibition which was destroyed at a yield 3 to 4 times that of the catalytic activity. When measured with pyruvate as substrate, only the GTP inhibition was more sensitive than the catalytic activity. The ADP and the sodium chloride inhibition were less radiosensitive. Thus, the allosteric effect of each particular effector showed widely different radiosensitivity when the enzyme was assayed with the two different substrates. The allosteric effects of ADP and GTP were affected in a similar way by x rays and sodium chloride, both with glutamate and pyruvate as substrate, while sulfhydryl blocking had a different effect. The results indicate that destruction of sulfhydryl groups by x rays is of minor importance for the radiation induced inactivation of the catalytic and allosteric activity of the enzyme. (auth)

43247 TEMPERATURE DEPENDENCE OF THE DIRECT ACTION OF IONIZING RADIATION ON BEEF HEART LACTATE DEHYDROGENASE: ENZYME ACTIVITY, SUBSTRATE, AND COENZYME AFFINITES. Fluke, Donald J. (Duke Univ., Durham, N. C.). Contract AT(40-1)-3631. Radiat. Res.; 51: No. 1, 56-71(Jul 1972).

Samples of lactate dehydrogenase (LDH), desalted by dialysis, were dried as hard films 0.1 to 0.25 mg/cm^2 in average thickness and were irradiated in a vacuum with minimum ionization electrons. After irradiation at controlled temperatures from 65°K to 395°K, samples were returned to ambient temperature, exposed to air, and dissolved in phosphate buffer. For study of effect upon solubility, samples were divided into spontaneous eluate and mechanical resuspendate fractions, each assayed for enzyme activity and for protein content. Both for total recoverable activity and for enzyme specific activity, the temperature dependence of radiation sensitivity is consistent with two principal modes of inactivation, one temperature-independent and the other characterized by an activation energy around 1200 cal/mole. The H4 isozyme and an isozyme mixture gave indistinguishable results. Some temperature dependence was also evident for effect upon protein solubility. The effect of radiation on affinity of LDH for the coenzyme NADH, as indicated by measurements of fluorescence of NADH–LDH mixtures, was much less than the effect upon catalytic activity of LDH. The two effects showed no relative difference for irradiation at 78°K or at 300°K. Similarly, the substrate kinetics were almost indistinguishable for control material and for material irradiated to $^1/_{100}$ activity remaining, for irradiation at 78°K or 300°K. (auth)

43248 DEPENDENCE OF CELLULAR RADIOSENSITIVITY ON Ca^{++}-IONS. Bergeder, H. D.; Rink, H. (Univ., Bonn). Strahlentherapie; 143: No. 3, 268-72(Mar 1972). (In German).

Radiation-induced shift of potassium and sodium ions across the cell membrane is reduced by the presence of Ca^{2+}-ions, yet augmented by the abstraction of Ca^{2+}-ions. Therefore, Ca^{2+}-ions have a densitizing effect with regard to the radiation effect on the cellular K$^+$ and Na$^+$ concentration, whereas the abstraction of Ca^{2+} has sensitizing effect. (auth)

Radiation Effects on Cells (External Source)

Refer also to abstract 43322.

43249 (COO-3013-24) EFFECTS OF IRRADIATION ON THE KINETICS OF PROLIFERATION AND DIFFERENTIATION IN CELL RENEWAL SYSTEMS. Fabrikant, Jacob I. (Connecticut Univ., Hartford. Dept. of Radiology). [1970]. Contract AT(30-1)-3970. 161p. Dep. NTIS.

A review is presented on the dynamic aspects of cell renewal systems, homeostasis of renewal tissues of the body, change of cell proliferation patterns with various kinds of perturbations, and the relation of cellular response and cell population kinetics to radiation effects on growth and differentiation of normal tissues of mice and men. Fundamental characteristics of certain rapidly and slowly proliferating cell renewal systems are described. Cellular control mechanisms and the regulation of the kinetics of cellular proliferation and differentiation are considered. Discussions are given of single and protracted radiation exposure of cell renewal systems and studies on homeostasis in irradiated tissues are reviewed. Consideration is given to model building of tissue response in relation to the component and organizational aspects of cell renewal systems giving rise to cell cycle effects and cell population effects, and particularly the implications for radiobiology of a number of recent developments that have influenced the direction of research in certain aspects of the radiation response of normal and neoplastic tissues. (H.L.W.)

43250 SYNTHESIS AND TURNOVER OF RIBONUCLEIC ACIDS IN SUSPENDED MAMMALIAN CELLS. III. INFLUENCE OF IONIZING RADIATION. Trams, Guenther; Vollertsen, Ingeborg; Koch, Gebhard (Univ., Hamburg). Z. Naturforsch.; 27b: No. 6, 714-17(Jun 1972). (In German).

The influence of ionizing radiation on the turnover of high molecular weight RNA in mammalian cells was studied. Growing cultures of suspended human amnion cells were labeled with ^{32}P and irradiated with different doses of x rays. RNA was isolated by hot phenol and the high molecular weight RNA fractionated by chromatography on methylated serum albumin celite columns. The salt gradient eluted RNA with sedimentation coefficients of 16 S or greater, which were characterized by analysis of nucleotide composition. Irradiation with doses from 900 to 6000 R results in degradation of pre-labeled RNA. A quantitative determination reveals that more ^{32}P-radioactivity leaves the high molecular weight RNA compared to labeled total material that is degraded to acid soluble products. This indicates that RNA is partly broken down to low molecular weight fragments. Nucleotide analysis of the high molecular weight RNA fractions indicates a preferred degradation of ribosomal precursor RNA. The experimental results give evidence that the analysis of RNA synthesis for a certain period after irradiation is complicated by interfering processes like the simultaneous degradation of RNA. (auth)

43251 POTENTIAL USE OF NITROFURANS IN RADIOTHERAPY. Reuvers, A. P.; Chapman, J. D.; Borsa, J. (Whiteshell Nuclear Research Establishment, Manitoba, Can.). Nature (London); 237: No. 5355, 402-3(16 Jun 1972).

It has been suggested that the hypoxic centers within tissues are likely to be relatively resistant to ionizing radiation. Compounds that could be introduced into these centers that could mimic the radiation sensitizing effect of O_2 may therefore be of value in the radiation therapy of cancer. In this connection, 5-nitrofuran derivatives were investigated, using Chinese hamster cells. The effect of 500 μM 5-nitro-2-furaldehyde-semicarbazone (nitrofurazone) on the survival of such cells irradiated in air and in hypoxic conditions is described. It was found that this compound strongly sensitizes hypoxic cells, whereas in air there was only a small degree of protection. Tests were also made with N-(5-nitro-2-furfurylidine)-1-aminohydantoin (nitrofurantoim) and similar results were obtained. Possible modes of action are discussed, and indications are that hypoxic radiosensitization is effected by a short-lived product, as opposed to a stable product. No acute toxicity in vitro was apparent. (UK)

43252 SENSITIZATION OF ANOXIC MAMMALIAN CELLS TO RADIATION BY TRIACETONEAMINE-N-OXYL. EFFECT OF PRE- AND POSTIRRADIATION TREATMENT. Agnew, D. A.; Skarsgard, L. D. (McMaster Univ., Hamilton, Ont.). Radiat. Res.; 51: No. 1, 97-109(Jul 1972).

It has been shown that exposure to triacetoneamine-N-oxyl (TAN) can enhance the damage produced in Chinese hamster cells by γ-radiation even if the drug is not present during irradiation. Preirradiation exposure to TAN gives a dose modifying factor (DMF) of 1.3 while postirradiation treatment with TAN can be nearly as effective as TAN present at the time of irradiation (DMF = 1.5). Postirradiation sensitization is strongly dependent on temperature and is only observed if TAN is added within a few minutes after irradiation. The mode of action of TAN in mammalian cells is therefore not the same as in bacterial cells where no postirradiation sensitization occurs. Electron spin resonance (ESR) measurements indicate that TAN is entering the cells but that at high cell concentrations there is a gradual decay of free spins which is accompanied by a small loss in sensitization. A much larger loss in sensitization, however, occurs very rapidly at these high cell concentrations (centrifugation pellets) without any apparent loss in spins. (auth)

43253 CELLULAR ASPECTS OF RADIOSENSITIZATION. Feinendegen, L. E. (Kernforschungsanlage, Juelich, Ger.). Strahlentherapie; 143: No. 3, 257-67(Mar 1972). (In German).

Concerning the role of radiosensitizers in improving the effectiveness of radiotherapy of malignant tumors, new knowledge has developed recently in the field of cellular radiobiology. A review is presented with emphasis on variations in radiosensitivity during the course of the cell cycle and the repair of sublethal lesions in genetic material. Additional topics reviewed are: mode of action of radiosensitizers such as oxygen, halogenated pyrimidines, and metabolic inhibitors; use of combination therapy for destroying tumor cells; use of radioactive labeled iodine-deoxyuridine for labeling proliferating cells; and tumor transplantation in mice. The need for further research on testing methods is pointed out. (H.L.W.)

43254 RADIOSENSITIZATION OF CELLS IN VITRO. Peters, K. W.; Peters, R. (Univ., Tuebingen, Ger.). Strahlentherapie; 143: No. 3, 273-7(Mar 1972). (In German).

The clone formation of HeLa-S3-cells can be promoted in vitro through steroids (testosterone, progynone, prednisolone) depending on the concentration employed. The combination of x-rays with steroid concentrations, producing an inhibition, causes additive effects, in the sense of a sensitization. If growth-stimulating steroid-concentrations are combined with x-rays, a process of sensitization remains demonstrable; it can, however, be compensated more or less through the concentration-dependent growth-stimulation. (auth)

43255 MOLECULAR BASES OF RADIOSENSITIZATION. Hagen, U. (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie; 143: No. 3, 237-43(Mar 1972). (In German).

The radiation damage of cells is due mostly to an alteration of the structure of DNA. Sensitization of the cell can be achieved, if the sensitivity of DNA is increased by incorporation of halogenated pyrimidines, for instance bromouracil. Moreover, the sensitivity increases if the repair of the DNA damages is inhibited by drugs. The molecular mechanisms leading to sensitization are discussed. (auth)

Radiation Effects on Microorganisms (External Source)

43256 RELATIVE BIOLOGICAL EFFECTIVENESS OF A BEAM OF FAST ELECTRONS. Kornev, I. I.; Kuznetsova, L. A.; Mil'shtein, R. S. (Moscow Scientific-Research Roentgeno-Radiological Inst.). Med. Radiol.; 16: No. 12, 65-7(Dec 1971). (In Russian).

The results of studies of the biological effectiveness of a beam of electrons with an energy of 22 MeV compared with bremsstrahlung with a limited energy of 25 MeV, carried out on lysogenic Escherichia coli K-12 (λ) bacteria are reported. (auth)

43257 UV REACTIVATION OF PHAGE λ IN A polA MUTANT OF E. COLI. Caillet-Fauquet, Perrine; Defais, Martine (Univ. Libre, Brussels). Mutat. Res.; 15: No. 3, 353-5(Jul 1972).

Mutants of Escherichia coli deficient either in uv reactivation only or in uv mutability only were obtained for studies on correlation of uv reactivation and uv mutability of lambda phage. A range of uv doses that do not affect the capacity of polA_1 mutants to support growth of lambda phage was used. Results indicated that uv reactivation and uv mutagenesis have some common pathways. (H.L.W.)

43258 RADIATION-INDUCED LETHAL SECTORING IN HAPLOID YEAST CELLS. de Langguth, Elia Nunes (Facultad de Medicina, Montevideo). Acta Physiol. Latinoamer.; 20: 382-9(1970). (In Spanish).

Observations of x-irradiated haploid bud-free yeast cells showed that clones produced by surviving cells frequently contain clusters of moribund giant cells among cells that are apparently undamaged (lethal sectoring). Lethal sectoring for haploid cells shows a strong dose-dependence, and for doses below 5 krads it was not observed. When the cells were irradiated during the radioresistant phase, they are able to recover from the potentially lethal genetic damage. However, these cells do not recover from the lesion determinating the lethal sectoring. These results and data from other authors lead us to conclude the extrachromosomal nature of this radiation damage. (auth)

43259 ISOLATION AND CHARACTERIZATION OF A T4 MUTANT PARTIALLY DEFECTIVE IN RECOMBINATION. van den Ende, P.; Symonds, N. (Univ. of Sussex, Brighton, Eng.). Mol. Gen. Genet.; 116: No. 3, 239-47(1972).

Starting with an rII diploid isolate of T4 a procedure is reported for isolating diploid variants which generate segregants at a reduced frequency. The properties of one such variant, which exhibits a four-fold reduction in segregation frequency, is discussed in detail. It is shown that this variant has acquired at least two extra mutations outside the rII region; these mutations confer a four to seven-fold reduction in recombination frequency as measured in standard phage crosses; the mutations also cause a 20% increase in uv-sensitivity and a marked effect both on multiplicity-reactivation and on the intracellular development of radiation-resistance. (auth)

43260 EFFECT OF IONIZING RADIATION ON ANIMAL VIRUSES. I. GAMMA RAY INACTIVATION OF AUJESZKY VIRUS. Dilovski, Marin (Inst. of Infectious and Parasitic Diseases, Sofia). Zentralbl. Veterinaermed., Reihe B; 19: No. 2, 128-35(1972). (In German).

The kinetics of the inactivation of Aujeszky virus infectivity by gamma irradiation depend on the viral titre, the radiation dose, and the irradiation temperature. Different cell species and media used for the cultivation of the virus have no effect on inactivation. A reversible change in the size of the plaques suggests an alteration of the phenotypic characters of the virus. The effect of gamma irradiation on the immunogenic properties of the virus is discussed in relation to vaccine production. (auth)

43261 MODIFICATION OF THE YIELDS OF SINGLE STRAND BREAKS IN DNA OF GAMMA-IRRADIATED ESCHERICHIA COLI. Ho, S. K.; Ho, Y. L. (Loma Linda Univ., Calif.). Radiat. Res.; 51: No. 1, 142-54(Jul 1972).

The yield of single strand breaks in DNA in the γ-irradiation of Escherichia coli 15 T^-, as measured by the alkaline sucrose gradient technique, is enhanced by two enzyme inactivating agents, namely, sodium cyanide and parachloromercuribenzoate (PCMB), but to different extents. The G-value of 0.26 obtained in air for the yield of single strand breaks in the absence of additives is increased to 1.4 by sodium cyanide and to 5.4 by PCMB. In nitrogen, the yield for sodium cyanide-treated cells is 0.55 and that for PCMB-treated cells 5.3. Irradiation of PCMB-treated cells in the presence of histidine gives a lower yield of 1.0. β-Mercaptoethylamine (MEA) completely neutralizes the enhancing effect of PCMB, the residual yield being 0.27. For cyanide-treated cells, both histidine and MEA give the same limiting yield of 0.45. The cell is apparently capable of rejoining by itself breaks attributable to free radical attack as well as some produced by the direct action of radiation. These results indicate that not all the strand rejoining processes can be suppressed by sodium cyanide and that, besides inactivating cellular repair enzymes, PCMB probably exerts a sensitizing effect in the production of single strand breaks by radiation. (auth)

43262 EFFECTS OF IONIZING RADIATION ON THYMIDINE UPTAKE INTO ESCHERICHIA COLI B_r AND B_{s-1}. Cramp, William A.; Elgat, Maya (Hammersmith Hospital, London). Radiat. Res.; 51: No. 1, 121-33(Jul 1972).

It is not possible to correlate the survival of Escherichia coli strains B_r and B_{s-1} with the general inhibition in the whole population of the rate of thymidine uptake soon after irradiation. At the same level of survival the more sensitive mutant B_{s-1} maintains for a short time a higher rate of thymidine uptake and DNA synthesis than does the more resistant mutant B_r; this is particularly noticeable after ionizing radiation in anoxic conditions. It is possible that the early relatively high rate of DNA synthesis in E. coli B_{s-1} results in the distribution of incorrect information from its radiation damaged DNA and thus a greater chance of cell death. After electron irradiation under aerated conditions, the rate of recovery of incorporation of thymidine into DNA is greater for E. coli B_r than for E. coli B_{s-1}. After irradiation under anoxic conditions, inhibition of incorporation is more marked for E. coli B_{s-1} than for E. coli B_r. These differences can be qualitatively related to the difference in radiation response of these two strains. (auth)

43263 EFFECT OF BACTERIOPHAGE INDUCTION ON THE REPAIR ABILITY OF ESCHERICHIA COLI 15 TAU. Kubelkova, A.; Krekulova, A.; Reslova, S.; Drobnik, J. (Charles Univ., Prague. Inst. of Macromolecular Chemistry, Prague). Folia Microbiol. (Prague); 17: No. 3, 184-91(1972).

The growth, lysis, and survival of Escherichia coli 15 TAU following uv irradiation was examined. An attempt was made to separate the repair processes and prophage induction by preincubation with chloramphenicol and subsequent incubation with chloramphenicol or caffeine. It was found that the prophage does not diminish the repair ability of cells that have survived the induction. It cannot be ascertained whether the cell fraction was induced at all or whether the induction was partially reverted subsequently. It can be concluded that the results derived from examining the survival of uv-irradiation cultures of Escherichia coli 15 TAU do not require any correction for phage induction. (auth)

Radiation Effects on Plants (External Source)

Refer also to abstract 43244.

43264 MATERIALY I VSESOYUZNOGO SIMPOZIUMA PO RADIOBIOLOGII RASTITEL'NOGO ORGANIZMA, 12–16 MAYA 1970. (Proceedings of the 1st All-Union Symposium on the Radiobiology of Plants, Kiev, May 12–16, 1970). Bidzilya, N. I. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1970). 208p. (CONF-700572).

Abstracts of the 103 papers presented at the symposium are presented. The theme of the symposium was plant radiobiology. Topics dealt with specifically included: the role of free radicals, radiolysis, radiotoxins, and peroxidation in the development of plant injuries caused by radiation; the RBE of different radiations for inducing plant injuries; the role of plant radiobiology in space biology and space radiobiology; the effect of radiation on plant chromosomes; the effects of radiation on nucleic acids and proteins in plants; the effects of planting irradiated seeds on the growth, development, and productivity of plants; the radiosensitivity of plants; chemical protection of plants against radiation; and post-irradiation recovery in plants. (E.R.B.)

43265 EFFECTS OF LOW, MODERATE, AND HIGH LEVELS OF GAMMA RADIATIONS (^{60}Co) ON SOYBEAN PLANTS IN ANALYSES OF GROWTH AND YIELD. Stan, S.; Croitoru, A. (Academia de Stiinte Agricole si Silvice, Bucharest). Stimulation Newslett.; No. 1, 23-7(1970).

Soybean seeds were exposed to ^{60}Co γ radiation of 25 to 20,000 R at a dose rate of 40 R/min. A stimulation of germination was found at doses up to 2000 R and also an increase in the yield of seedlings. During the formation of the first trifoliate leaf, the plants grown from seeds irradiated with doses higher than 2000 R showed dose-dependent changes of leaves, stems and branches. A stimulation of flowering was found between 25 and 500 R; doses higher than 5000 R caused a retardation. Low doses up to 2000 R increased the yield. (INIS)

43266 X-RAY INDUCED STIMULATION OF GROWTH IN OCIMUM KILLIMANDSCHARICUM. Joseph, B.; Gaur, B. K. (Bhabha Atomic Research Centre, Bombay). Stimulation Newslett.; No. 1, 34-8(1970).

Seeds of Ocimum killimandscharicum were irradiated with 125 to 2500 R of x rays at a dose rate of 200 R/min. After the planting of the 6 week old seedling in the field, the fresh and dry weight and chlorophyll content were determined in regular intervals. Leaves and stems showed a similar radiation stimulation during the first weeks. A significant increase of chlorophyll content was found in plants irradiated with 1500 R. Furthermore, a stimulation of flowering was observed. (INIS)

43267 EFFECTS OF LOW, MODERATE, AND HIGH LEVELS OF GAMMA RADIATIONS (^{60}Co) ON SOYBEAN PLANTS. PART 2. CHANGES IN PROTEIN, OIL, AND MICRONUTRIENT CONTENT. Stan, S.; Croitoru, A. (Academia de Stiinte Agricole si Silvice, Bucharest). Stimulation Newslett.; No. 2, 11-14(1971).

Soybean seeds were exposed to 25 to 20000 R of ^{60}Co γ rays at a dose rate of 40 R/min. The analysis of protein content of two growth stages revealed an increase at 15000 and 20000 R, and in mature seeds at 10000 R. The content of micronutrients (Zn, Fe, Mn, Cu) and oils in the seeds was also increased. (INIS)

43268 INVESTIGATIONS ON DELAYED EFFECTS OF IONIZING IRRADIATION. PART 2. STIMULATION EFFECTS ON YOUNG TOMATO PLANTS (LYCOPERSICON ESCULENTUM L.) AFTER EXPOSURE OF THE SEEDS OF THE PARENTAL GENERATION TO HIGH DOSES OF X RAYS. Schwanitz, F.; Schwanitz, H. (Kernforschungsanlage, Juelich, Ger.). Stimulation Newslett.; No. 2, 20-6(1971).

Dry seeds of tomatoes were irradiated with high doses of X-radiation (20 to 40 kR). The plants grown from these seeds indicated radiation damage, such as diminished growth and reduced fertility. The second generation, however, showed an increased growth even if they had been irradiated as young plants. The germination, size of cotyledons and fresh weight of young and of 3-month old plants were compared, i.e. plants which were either unirradiated controls, or which received a radiation treatment in the 1st, 2nd, or in both generations. In all cases the plants irradiated in the 1st generation exceeded the controls. Besides the enhanced growth, a greater efficiency of fertilizers was found as well. (INIS)

43269 INVESTIGATIONS ON DELAYED EFFECTS OF IONIZING IRRADIATION. PART 1. STIMULATION EFFECTS ON YOUNG KALE PLANTS (BRASSICA OLERACEA L. ACEPHALA D. C.) AFTER EXPOSURE OF SEEDS OF THE PARENTAL GENERATION TO A HIGH DOSE OF X RAYS. Schwanitz, H.; Schwanitz, F. (Kernforschungsanlage, Juelich, Ger.). Stimulation Newslett.; No. 2, 15-19(1971).

Dry seeds of kale were irradiated with 75 kR of x rays. Only 5 out of 40 plants developed and produced a reduced number of seeds in the following year. One hundred of these seeds were sown, totogether with 100 control seeds, and their growth was controlled. The descendants of the irradiated seeds showed accelerated development and after 4 weeks their wet weight exceeded that of the control seeds by 58%. Fertilizers, too, showed a greater efficiency in these plants. (INIS)

43270 EFFECTS OF LOW DOSES OF RADIATION ON YIELD STRAWBERRY (FRAGARIA ANANA'SSA). Fendrik, I. (Technische Univ., Hanover). Stimulation Newslett.; No. 1, 8-12 (1970).

Three species of strawberries were irradiated in the vegetative stage with ^{60}Co γ rays or with x rays of different energies. The doses amounted to 4 to 10000 R. The growth conditions were made as optimal as possible. An analysis was made of total yield in the next year, of number and average weight of fruits. As expected, an increase of the yield was found in low dose range and a decrease after high doses. The best dose range seems to be 100 to 400 R, depending on the species. A significant increase of size of fruit could not be observed. An estimation of cost for a 1% increase of the yield is given. (INIS)

43271 RADIOSENSITIVITY OF TULIP POLLEN. Kudrautsava, V. M. (Central Botanical Garden, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 2, 22-32(1972). (In Belorussian).

Pollen from 44 varieties of tulips was subjected to 10 to 12 R/sec of gamma radiation for integral doses of from 500 to 10,000 R. The viability of the pollen served as an indicator of its resistance to radiation damage. No correlation between the degree of radiosensitivity of one variety or another could be established. Certain conclusions are drawn regarding the practical use of irradiated pollen. (tr-auth)

43272 EFFECTS OF GAMMA IRRADIATIONS ON TRITICUM AESTIVUM L: STUDIES ON CHANGES IN TILLERING CAPACITY AND EAR CHARACTERS OF KENYA WHEAT. Abidi, Zafar Husain; Oggema, Matthias Wanyama (Coll. of Agriculture, Tandojam, Pakistan). Nucleus (Karachi); 8: No. 4, 95-106(1971).

Five Triticum aestivum varieties of wheat were subjected to three different gamma radiation doses using a ^{60}Co source for examination of the chances of increasing their potential of variability for tillering and ear characters. (auth)

43273 RADIOSENSITIVITY OF SEEDS OF SOME NATURAL AND EXPERIMENTAL POTATO AUTOPOLYPLOIDS. Olimpienko, G. S.; Kirillovskaya, N. A.; Mitrofanov, Yu. A.; Volkova, R. I. (Inst. of Biology, Petrozavodsk, USSR. Inst. of General Genetics, Moscow). Tsitol. Genet.; 6: No. 1, 57-63(1972). (In Russian).

Radioresistance was investigated in seeds of some wild species and experimentally obtained polyploids of potato differing in resistance to low (negative) temperatures. Seed survival, percentage of chromosome aberrations in root tip cells, size of interphase nuclei and chromosomes, and size variabilities of nuclei in a cellular population served as tests. When comparing the natural tetraploid and experimental octaploid of the species Solanum schreiteri Buk. and S. punae Juz., the autopolyploids of S. schreiteri proved to be the most radioresistant but they are inferior to the former in their resistance to negative temperatures. The experimental polyploids appeared to be more radiosensitive than natural ones. An inverse correlation between interphase nucleus sizes and resistance to low temperature was detected among both the natural species and their octaploid forms. (auth)

43274 CRITERIA OF PLANT RADIOSENSITIVITY. Valodzin, U. G.; Kartel, M. A.; Lisouskaya, Z. I. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 1, 65-8(1972). (In Belorussian).

Air-dried seeds of various species were gamma-irradiated with 20,000 R doses at a rate of 600 R/min. Indicators of radiosensitivity such as chromosomal aberrations, reduction in germination and survival rate, percent of striped sprouts, and changes in certain quantitative characters, were analyzed. Those indicators best reflecting plant-radiation reaction were chromosomal aberrations, field germination, and survival. All other indicators were more or less modified in the vegetation process. (tr-auth)

43275 EFFECT OF LOW DOSES OF IONIZING RADIATION ON THE GROWTH AND RESPIRATION OF YEAST AND BROAD BEANS. Sidrak, G. H. (West Indies Univ., Mona, Jamaica). Stimulation Newslett.; No. 1, 1-3(1970).

Saccharomyces cerevisiae was irradiated while dry and then cultured at 250°C. There was an increase of cell proliferation and of oxygen consumption. Within the experimental dose range of 1 to 1000 R, the maximal efficiency was found at 10 and 100 R. Other strains showed differing maxima and dose response. The irradiation of seeds of Vicia faba did not cause any change of weight. Neither was there found any effect on the oxygen consumption of root tip cells. (INIS)

43276 EFFECT OF THE γ-IRRADIATION OF SEEDS ON A CHANGE IN ANTIRADICAL ACTIVITY IN VICIA FABA AND TRIFOLIUM PRATENSE SHOOTS. Seisebaev, A. T.; Gaziev, A. I.; Laps, O. N.; Khavaev, A. A.; Babaeva, M. K. (Inst. of Experimental Biology, Alma-Ata, USSR). Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol.; No. 7, 59-64(1970). (In Russian).

Air-dried seeds were γ irradiated with a ^{137}Cs source at 500 R/min. Three-, 7-, and 12-day-old broad beans were irradiated with 0.1 and 10 krads, and clover with 10 and 200 krads. The material was fixed in liquid N and lyophilized. A significant increase in water-soluble and protein antioxidants was observed in the irradiated seeds on the 12th day of growth. The activity of the chelate-forming and fat-soluble antioxidants was not different from that of the control. The reaction with di- and polyhydroxy aromatic compounds, ascorbic acid, and SH-compounds was more intense in broad bean extracts (max. in the broad beans irradiated with 10 krads) than in clover extracts. The SH level was 3 to 4-fold higher in the clover than in the broad beans. A direct relation was observed between the tissue total antiradical activity, the component polyphenols, and ascorbic acid content and broad bean and clover radiosensitivities. (Euratom)

Radiation Effects on Animals (External Source)

Refer also to abstract 43383.

Man

Refer also to abstracts 43253, 43371, 44503, and 45055.

43277 (ACRH—1000-328) THYROID SCANNING IN THE PEDIATRIC PATIENT: THE ADVANTAGES OF THE FLUORESCENT TECHNIQUE. Hendrix, Ronald W.; Hoffer, Paul B. (Chicago Univ., Ill. Dept. of Radiology. Argonne Cancer Research Hospital, Chicago, Ill.). Feb 1972. Contract AT(11-1)-69. 16p. (CONF-720212—1). Dep. NTIS.

From Conference on pediatrics in nuclear medicine; Baltimore, MD. (18 Feb 1972).

The radioinduced fluorescent thyroid scanning technique, using an external sealed ^{241}Am γ source for the excitation of interstitial iodine, was evaluated for use in pediatric and adult patients. Numerous advantages favor the fluorescent technique over radionuclide scanning in pediatric patients. The patient receives no total body or gonadal radiation, and the thyroid receives approximately 15 millirads as compared with multirad doses for a radionuclide scan. Specific information about iodine content of the gland is available only via the fluorescent technique. This information makes it possible to distinguish primary from secondary hypothyroidism. The image quality of the fluorescent scan appeared to be about the same as the nuclide scan whenever both were available. Increased iodine content was found in the glands of seven pediatric patients who had been on steroid therapy for three months to four years. Six of these patients had inflammatory bowel disease and one presumably had Wegner's granulomatosis. (C.H.)

43278 (AE—449) PERSONNEL DOSIMETRY AT STUDSVIK DURING 1971. Hedlin, L.; Widell, C.-O. (Aktiebolaget Atomenergi, Studsvik (Sweden)). May 1972. 8p. Dep. NTIS (U. S. Sales Only).

The results of personnel dosimetry at AB Atomenergi, Studsvik, during 1971 are presented. Twenty seven thousand two hundred gamma films and 3,700 neutron films were evaluated. One hundred and eight urine analyses and 1,288 measurements of body activity were made. The external total body dose for all employees (monthly doses <50 mrem are not reported) corresponds to 188 manrem. The highest external total body gamma dose during 1971 to one person was 8,400 mrem. (auth)

43279 (NP—19353) ANNUAL REPORT TO THE DIRECTOR-GENERAL OF HEALTH FOR THE YEAR ENDED 30 JUNE 1971. (Commonwealth X-Ray and Radium Lab., Melbourne (Australia)). 1972. 32p. Dep. NTIS (U. S. Sales Only).

Routine activities of the laboratory are reported for the period ending June 30, 1971. Included among these activities are the maintenance of facilities for the following: absolute standardization and comparative measurement of medical radioisotopes; standardization of x-ray exposures in the range of 50 to 250 keV; and measurement of β particle exposures. The laboratory also provides advisory service on x-ray equipment, storage facilities for radium, supply of radon for medical and research activities, and sole authority for the purchase and distribution or radioisotopes and radiopharmaceuticals for the common wealth. Data collected during 1970 and 1971 on the ^{90}Sr content of bone, milk, soil, and flour in Australia are presented in tabular form. Data on the radioactivity in the atmosphere, rain water, and tap water are also presented. (E.R.B.)

43280 LEUKOCYTE RESPONSE TO EXERCISE IN ATOMIC BOMB SURVIVORS. Belsky, Joseph L.; Ishimaru, Toranosuke; Ohashi, Toshiro; Robertson, Thomas L.; Taniguchi, Banri (Ato (Atomic Bomb Casualty Commission, Hiroshima. Atomic Bomb Casualty Commission, Nagasaki). Radiat. Res.; 50: No. 3, 699-707(Jun 1972).

Two hundred and fifty-four male and female subjects of a population of Hiroshima and Nagasaki followed for delayed effects of atomic bomb (A-bomb) radiation were examined for changes in circulating leukocytes before and after moderate exercise. The exercise was an augmented two-step test used routinely for cardiac evaluation. None had postexercise ischemic electrocardiogram changes. An immediate increase in mean pulse rate (70.2–120.6/minute) was obtained. The group showed statistically significant increased means for total white blood cell (WBC) count (by 33%), mature granulocytes (20%) and lymphocytes (60%). Comparison of pre- and postexercise counts showed no relation to A-bomb radiation dose. For granulocytes incremental change correlated with initial granulocyte and lymphocyte counts and with age, but not with change in pulse or radiation dose. Findings for total WBC and lymphocyte counts are given. The observation that the circulating granulocyte pool is similarly responsive to exercise stimulation in A-bomb survivors and controls still does not rule out possible radiation-induced changes in hematopoietic capability. Changes in lymphocytes, while striking, are difficult to interpret because of their extramedullary sources. (auth)

43281 CLINICAL AND EXPERIMENTAL RESULTS OF INTERSTITIAL BRACHY-CURIETHERAPY COMBINED WITH RADIOSENSITIZERS IN INFILTRATIVE BRAIN TUMORS. Mundinger, P.; Vogt, P.; Jobski, Ch.; Fischer, H. U.; Ostertag, Ch. (Univ., Freiburg i. B.). Strahlentherapie; 143: No. 3, 318-28 (Mar 1972). (In German).

A summary of experimental investigations is presented on the solid dimethylaminostilbene-carcinosarcoma of the rat and of therapeutic results of human brain tumors with the postoperative stereotaxic, interstitial brachy-curietherapy using contact γ irradiation after premedication with the radiosensitizers bromine-deoxyuridine and brominedeoxycytidine, bromineuracil and deoxyguanosine, and the antimetabolites fluorouracil and methotrexate-, which increase the BUDR-intake into the tumor-DNA. The findings show that in the DS-carcinosarcoma of the rat, BUDR is more effective than BU, BCDR and deoxyguanosine, and the combination with methotrexate augments the sensitization more than with fluorouracil or azathymine-, which blocks the intake. Clinically the postoperative survival times are extended. For this purpose it is necessary to reduce the interstitial radiation dose to avoid local radiation reactions and edema. (auth)

43282 USE OF NAPHTHALENEDIOL AS A RADIOSENSITIZER DURING RADIATION TREATMENT OF PATIENTS SUFFERING FROM MALIGNANT NEOPLASMS. Klimenko, A. A.; Karlashenko, N. I. (Moscow Scientific-Research Roentgeno-Radiological Inst.). Med. Radiol.; 16: No. 12, 41-3(Dec 1971). (In Russian).

Results are given of clinical experience with synkavit (2-methyl-1,4-naphthalenediol) as a radiosensitizer in 65 patients with malignant neoplasms and who were undergoing radiation therapy. The preparation, when administered internally, was non-toxic and may be used in clinical practice, although its radiosensitizing effect is insignificant. (tr-auth)

43283 LATE COMPLICATIONS OF THE RECTUM AND SIGMOID AFTER RADIATION TREATMENT OF CARCINOMA OF THE UTERINE CERVIX. Kavkalo, N. N.; Moldovan, V. I.; Kokhanovskaya, R. S. (Chernovtsky Medical Inst., USSR. Chernovtsky Regional Oncology Dispensary, USSR). Med. Radiol.; 16: No. 12, 36-40(Dec 1971). (In Russian).

The rectum and sigmoid were investigated in 143 women at periods ranging from 3 months to 12 yrs after combined radiation treatment of carcinoma of the uterine cervix. During the first year after treatment, there were noted catarrhal or erosive-desquamative radiation rectitis, in 1 to 2 yrs—infiltrative-ulcerous, in 4 to 10 yrs—chronic radiation ulcers and sclerotic changes of the wall. Rectovaginal fistulas were observed in two patients suffering from diabetes mellitus. (auth)

43284 DEVELOPMENT OF FLUID IN PLEURAL CAVITIES IN PATIENTS WITH LUNG CANCER IN THE POSTRADIATION PERIOD. Pereslegin, I. A.; Zubchuk, N. V.; Baryshnikova, S. D.; Savina, E. B. (Moscow Medical Inst.). Med. Radiol.; 16: No. 12, 18-21(Dec 1971). (In Russian).

The mechanism of accumulation of fluid in the pleural cavities in 11 patients out of 53 with postradiation pneumosclerosis and in 5 patients out of 38 with a relapse of lung cancer after radiation therapy is analyzed. The authors noted a direct relation between the degree of postradiation changes and the frequency of fluid detection in the pleural cavity and showed the importance of pleural puncture in determining the nature of the fluid. (auth)

43285 RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. ADOPTED SEPTEMBER 17, 1965. CIPR-9. Fontenay-aux-Roses, France; Centre d'Etudes Nucleaires ([1971]). 62p. (In French).

Translation of Recommendations of the International Commission on Radiological Protection, Oxford, Pergamon Press.

The fundamental principles of the ICRP recommendations for radiation protection are reviewed: radiological protection, dose equivalents, dose rates, critical tissues and organs, radiation hazards, the various types of irradiation (exposure of individuals or the population). The limitation of doses in the case of exposure to controlled radiation sources and the levels for intervening in the case of exposure to noncontrolled sources were investigated. General principles for the development of radiation protection guides are given. (France)

43286 EXPOSURE EVALUATION OF PERSONNEL DEALING WITH CLINICAL RADIUM APPLICATORS. Dworakowski, Marian; Lobodziec, Wlodzimierz; Musialowicz, Tadeusz; Wysopolski, Juliusz (Inst. of Oncology Warsaw). Nowotwory; 22: No. 1, 79-88(1972). (In Polish).

The results of radiation dose measurements for radiation exposure evaluation of persons dealing with medical radium applicators at the Institutes of Oncology in Warsaw and in Gliwice are presented. The photographic method was chosen for this measurement. The doses were simultaneously measured in six points of the body: on the head, chest (left side), ring fingers (left and right hand); and at the height of gonads (left and right side). For nurses preparing radium applicators gamma ray exposure doses were additionally measured on the finger bulbs. Evaluation of radiation exposure indicates that the measured doses exceeded the permissible values only for finger bulbs. It was concluded that radiation exposure may be considerably reduced by using other constructions of applicators, additional shielding facilities as well as automation of preparation, transport, and dismantling of applicators. (auth)

43287 ANALYSIS OF FAILURES IN TREATMENT OF SKIN CANCER. Wronkowski, Zbigniew (Inst. of Oncology, Warsaw). Nowotwory; 22: No. 1, 51-8(1972). (In Polish).

Three causes of failures in treatment of skin cancer were analyzed: recurrences, metastases, and radiation necrosis. The study was carried out on 5,855 patients treated for skin cancer at the Institute of Oncology in Warsaw in the years 1947 through 1967. The frequency of failure causes was as follows: recurrences—2%, metastases 3.2%, and radiation necrosis—5.9% of cases undergoing radiotherapy. The frequency of recurrences (7.0%) and metastases (19.9%) was significantly higher in cases of planoepithelial cancer. The frequency of radiation necrosis was increased significantly after higher dose of radiation (above 6,000 R per field or 2 mcd/cu cm). The development of recurrence or metastasis effects the prognosis, while the appearance of radiation necrosis is without effect on the results of treatment. (auth)

43288 NEOPLASMS AFTER IRRADIATION IN INFANCY. Hempelmann, L. H. (Univ. of Rochester, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 63(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43289 CARCINOGENIC EFFECTS OF OBSTETRIC RADIOGRAPHY. Stewart, Alice (Oxford Univ.). Trans. Amer. Nucl. Soc.; 15: No. 1, 63(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43290 CHROMOSOME ABNORMALITIES IN HUMAN LOW DOSE RADIATION EXPOSURE. Wald, Niel (Univ. of Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 1, 64(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43291 COMPARISON OF RADIATION EXPOSURE OF THE POPULATION FROM MEDICAL DIAGNOSIS AND THE NUCLEAR ENERGY INDUSTRY. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 64-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43292 ASSESSMENTS OF RADIATION DOSES TO MAN FROM VARIOUS COMMON SOURCES. Barr, N. F. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 449(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43293 DEPENDENCE OF FRACTIONAL CELL LETHALITY FOR BONE MARROW ON SPACE PROTON FLUENCE AND SPECTRUM. Billings, M. P.; Langley, R. W. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 559-60(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43294 RADIOSENSIBILIZATION IN FUNGOID MUCOSIS THROUGH POISONS OF MITOTIC SPINDLE FORMATION. Wiskemann, A. (Univ., Hamburg). Strahlentherapie; 143: No. 3, 338-40(Mar 1972). (In German).

In 21 patients suffering from fungoid mycosis of stages I to III, after an x-ray treatment of one to twelve years duration, a reduced sensitivity to a dose of 300 R was observed. The irradiation was carried out in large-field technique with a soft-ray tube of 50 kV, without a filter, 120 cm focus-skin distance or skin irradiation from 30 to 15 cm focus-skin distance, 29 to 90 kV and Al-filter. If we injected 4 mg of Colzemid i.v. 16 hours prior to irradiation, we again observed as a rule a marked therapeutic success. In the same way it was possible to compensate the reduced radiosensitivity in giving 400 mg of Proresid i.v., if the poison of mitotic spindle formation had been applied 16 hours before starting irradiation. (auth)

43295 AUTOMYELOTRANSPLANTATION IN LOCAL FRACTIONAL IRRADIATION. **Baisogolov, G. D.; Pavlov, V. V. (Inst. of Medical Radiology, Moscow). Med. Radiol.; 17: No. 3, 14-19(Mar 1972). (In Russian).**

Data on the state of hematopoiesis in the sternum in 11 patients suffering from lymphogranulomatosis who, after local fractional irradiation of the mediastinum, underwent intrasternal transplantation of autologous bone marrow are presented. The total absorbed dose of irradiation in the sternal bone marrow varied from 3700 to 5100 rad. The number of transplanted cells was 1.1 to 2.9 × 10^9. Within the first two months after transplantation in five patients, signs of restoration of hematopoiesis were observed. A conclusion is made that automyelotransplantation does not ensure a persistent restoration of hematopoiesis at areas where the total absorbed dose of irradiation exceeds 3000 ± 500 rad, as the result of which the duration of aplasia of these areas could not depend on the intensity of migration of stem myeloid cells. (auth)

43296 DOSAGE CHARACTERISTICS OF SECONDARY ELECTRONS ON THE AIR-SKIN BOUNDARY IN TELEGAMMA-THERAPY. **Korf, N. N.; Sterin, A. M. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 17: No. 3, 67-70(Mar 1972). (In Russian).**

A method is described for determining the dose distribution in surface layers of the skin for various angles of incidence of γ quanta. The depth distribution of dose was evaluated as a function of the incident angle to the irradiated surface. The dependence of the energy absorbed in a sensitive skin layer on the incident angle was determined. (tr-auth)

43297 ESTIMATION OF DEPTH gamma RADIATION SPECTRA IN TISSUE-EQUIVALENT PHANTOMS BY USING THE MONTE CARLO METHOD. **Kopytkin, Yu. V.; Pozdneev, D. B.; Speranskii, S. K. (Gorky State Univ., USSR). Med. Radiol.; 17: No. 3, 76-87(Mar 1972). (In Russian).**

The Monte Carlo method was used in estimating depth γ-radiation spectra in a heterogenous tissue-equivalent phantom consisting of muscle and pulmonary tissues in the shape of an elliptic cylinder. Quantitative values for a ^{60}Co γ-quanta divergent beam are adduced. (auth)

43298 MALIGNIZATION OF OSTEOBLASTOCLASTOMA FOLLOWING RADIATION THERAPY APPLIED LONG AGO. **Kaliteevskii, P. F.; Kheifets, R. A. Arkh. Patol.; 34: No. 5, 78-81(1972). (In Russian).**

A case of malignant changes in a osteoblastoclastoma on the fibula 16 yrs following radiotherapy is described. It is of interest that only half of the tumor underwent malignant changes whereas another half retained a typical structure of osteoblastoclastoma, possibly because of the shielding of this part of the tumor during the exposure. (auth)

43299 APTITUDE AND MEDICAL SURVEILLANCE OF PERSONS WORKING WITH RADIATIONS. Letard, Henry (Electricite de France, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 91, 27-33(Sep 1971). (In French).

The various dispositions legally envisaged for determining the aptitude of persons for work with radiations are described from the point of view of the twelve years of experience gained. Current practice with regard to the real risks occurring in nuclear plants, is described. The three-fold aspect of the medical surveillance of workers is described: clinical examinations at six month intervals; blood tests at six month intervals; radiation monitoring of the individual; and the detection of internal contamination. Professional illnesses due to ionizing radiations are briefly discussed. (France)

43300 INDUSTRIAL MEDICINE PROBLEMS IN NUCLEAR PLANTS: THE NECESSARY LIAISON BETWEEN THE DOCTORS OF EXTERNAL ENTERPRISES AND DOCTORS OF THE EDF. Paris, Jean (Electricite de France, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 91, 25-6(Sep 1971). (In French).

Two categories of worker are employed in the power installations of l'Electricite de France (EDF): the employees of the EDF, who are the personnel of the plant and under the surveillance of the doctors of the plant; the personnel of external enterprises working for the EDF under the surveillance of the doctors of the individual enterprises concerned. The external enterprises can delegate their responsibilities to the doctor at the site. The necessity of having permanent well established liaisons between the three categories of doctors (in spite of the professional secrecy code) in order to maintain an effective medical surveillance is emphasized. (France)

43301 STATISTICAL STUDIES OF UROLOGIC DISEASES FOLLOWING THE OPERATION AND RADIATION THERAPY OF CANCER OF THE CERVIX. **Satake, Minoru; Yagihashi, Saburo; Mizumoto, Shuji (Sapporo Medical Coll.). Sanfujinka No Sekai; 23: No. 2, 167-70(Feb 1971). (In Japanese).**

A statistical investigation was carried out concerning urinary complications occurring in 1,134 patients with cancer of the cervix treated following surgery with radiation therapy. The incidence of urinary fistula accompanying transvaginal total hysterectomy with extraperitoneal lymphadenectomy was 2.4% vesicovaginal fistula was 2.2%; and other urologic disease was 9.1%. Urinary complications due to radiation therapy were observed in 6.9% of cases in the following order: cystitis 4.7%; hydronephrosis and hydroureter 1.8%; and others about 0.6%. (Japan)

43302 UTILIZATION OF AN ELEMENTAL HYDROLYZED DIET IN CHEMOTHERAPY AND RADIOTHERAPY WITH GAMMA RADIATION. **Bounous, G.; Gentile, J. M.; Hugon, J. (Univ. Sherbrooke, Quebec). Union Med. Can.; 101: No. 6, 1168-71 (Jun 1972). (In French).**

An elemental diet containing amino acids instead of proteins was shown to protect the intestinal epithelium of experimental animals against the lesions associated with 5-FU, irradiation, and shock. In the two latter experiments, the intestinal improvement was associated with decreased mortality. In patients eating a normal hospital diet, palliative γ treatment of advanced metastatic carcinoma was associated with significant weight loss and specific lesions of the rectal mucosa. A comparable group of patients eating a hydrolyzed elemental diet (Mead-Johnson 3200-A.S.) four days before and throughout the six to nine days of 5-FU treatment had no rectal lesions and maintained their pretreatment body weight. (auth)

43303 CONTINUOUS INTRA-ARTERIAL INFUSION OF VARIOUS RADIOSENSITIZERS ON CANCER OF PARANASAL SINUS. Sakai, Shun-ichi; Shigematsu, Yasushi; Fuchihata, Takeshi (Osaka Univ.). Jibi Inkoka Rinsho; 63: No. 10, 941-52(Oct 1970). (In Japanese).

In order to observe the effect of radiosensitizers, 5-Fluorouracil (5-FU), Cyclohexanol-succinate (CHX), Ametohepazone (AMH), and Bleomycine (BLM) were used to determine how much the combination of their continuous arterial infusion and radiotherapy would contribute to the improvement in the therapeutic results. The dose was 250 mg/tube × 10 to 20 tubes for 5-FU, 500 mg/tube × 20 to 40 tubes for CHX, 10 mg/tube × 40 to 80 tubes for AMH, and 15 mg/tube × 10 to 20 tubes for BLM. The period of administration ranged from 4 to 8 weeks. Although there were differences in the dose and period of administration by local response and the condition of the pump for arterial infusion, an effort was made to administer as large a dose as possible over the entire period of radiotherapy. The radiation treatment consisted as a rule of daily irradiation to 200 R of tele-cobalt with the total tumor dose of 8000 R/8 weeks. The subjects for the present study were 105 patients with primary cancer in the maxillary sinus that was diagnosed as carcinoma in situ or undifferentiating cancer initially examined from January 1967 to August 1969. They were distributed randomly into 25 cases of 5-FU, 18 cases of CHX, 10 cases of AMH, 7 cases of BLM, and 45 controls (treated singly with radiotherapy not combining arterial infusion). It was confirmed that the distribution was performed without significant differences according to the progress of local tumor, age, and sex. Statistically significant differences in the therapeutic results were observed in the non-relapse rates in a half year and in a year for the 5-FU group. Against the non-relapse rate in a half year for the control group (27%), that of the 5-FU group was 60%, and against the non-relapse rate in a year for the control group (16%), that of the 5-FU group improved to 48%. It is a future issue whether or not these differences will effect the recovery rate. (Japan)

43304 MENINGIOMA OCCURRING IN A PATIENT TREATED FOR MEDULLOBLASTOMA. **McCormick, William F.; Menezes, Arnold H.; Grin, Oliver D. Jr. (Univ. of Iowa, Iowa City). J. Iowa Med. Soc.; 62: No. 2, 67-71(Feb 1972).**

The occurrence of a large cerebral meningioma in a young man 15 yrs after successful treatment for a cerebellar medulloblastoma is recorded. The rarity of medulloblastoma and meningioma in the same patient and the possible relationship between radiation therapy and the development of the meningioma are discussed. (auth)

43305 ARTERIOSCLEROSIS INDUCED BY RADIATION. Hayward, R. H. (Scott and White Clinic, Temple, Tex.). Surg. Clin. N. Amer.; 52: No. 2, 359-66(Apr 1972).

The effects of irradiation on tissues and small vessels are well known. However, isolated reports of irradiation damage to larger arteries suggest that this complication is uncommon, incompletely investigated, or infrequently reported. In the case presented herein, there is little doubt that localized and premature arteriosclerosis was promoted by previously administered external irradiation. (auth)

43306 RADIOTHERAPY OF MALIGNANT TUMORS AFTER SYNCHRONIZATION OF THE CELL DIVISION RHYTHM. EXPERIENCES AFTER TWO YEARS OF CLINICAL APPLICATION. Nitze, H. R.; Ganzer, U.; Vosteen, K.-H. (Univ., Frankfurt am Main). Strahlentherapie; 143: No. 3, 329-37(Mar 1972). (In German).

It was attempted to synchronize human tissue in vivo by a fluorouracil long-term infusion of 18 and 12 hours duration. The demonstration of a successful synchronization was achieved by the determination of the ^{3}H-marking and mitotic index, showing an alternating tide during the first ten hours. Patients with regionally localized tumors of the ENT-region were irradiated, the fluorouracil long-term infusion being terminated after 8 hours, with 500 rad per exposure (fast electrons) twice a week up to a total dose of 6000 rad, to affect the synchronized cells in the radiosensitive G_2-phase. In more than half of the patients treated so far in this way, an excellent regression of the tumor occurred which in almost half of all the cases treated persisted during the average observation time of about one year. (auth)

43307 STUDY OF THE EXPOSURE DOSES OF RADIATION WORKERS IN THE PHILIPPINES. Tan, Phoebe; Bustamante, Norma (Philippine Atomic Research Center, Diliman). Philipp. Nucl. J.; 2: No. 2, 223-7(1970).

A study of the exposure doses of radiation workers in the Philippines was made from 1963 to 1969 using the film badge service record of the Health Physics Department, Philippine Atomic Research Center. The radiation workers were classified into three groups: those employed in industrial firms, those involved in the medical uses of ionizing radiation, those employed in research organization. The usefulness of film dosimetry is discussed briefly. (auth)

43308 SOME CYTOKINETIC AND HISTOPATHOLOGIC CONSIDERATIONS OF IRRADIATED MALE AND FEMALE GONADAL TISSUES. Lushbaugh, C. C.; Ricks, R. C. (Oak Ridge Associated Universities, Tenn.). Front. Radiat. Ther. Oncol.; 6: 228-48(1972).

A review of the literature on radioinduced damage to male and female gonadal tissues is presented with emphasis on correlation of radiation dose with histopathological effects. A comparison of studies on recovery kinetics of irradiated germinative epithelium in mice with similar studies in man showed that in man spermatocyte production begins long before adequate numbers of spermatogonia are accumulated to generate the large numbers of sperm required for human male fertility. Reviews are presented of cases of accidental human exposure to beta and gamma radiation and slow and fast neutrons; one case indicated that a period of seven years may be required to return to initial levels of sperm production after sterilizing doses of radiation. Mechanisms of recovery of ovaries from radiation damage are discussed and studies using rats and mice are compared with those on the human female. Tables based on data from the literature are presented to show estimated ovarian tolerance levels of the human and of mice. Studies on radiosensitivity of ovaries of mice, rats, and rabbits showed that sterilization can be produced with much less than lethal total-body exposures, while this is not true for guinea pigs, monkeys, and man. (H.L.W.)

Vertebrates

43309 (COO-3013-55) CELL PROLIFERATION IN LYMPHOID TISSUE AND THE SEMINIFEROUS EPITHELIUM UNDER CONTINUOUS LOW LEVEL IRRADIATION. Progress Report, October 1, 1970–July 15, 1972. Fabrikant, Jacob I. (Connecticut Univ., Farmington. Dept. of Radiology). 1972. Contract AT(11-1)-3013. 80p. Dep. NTIS.

Research on the kinetics of cell proliferation in lymphoid tissues of the spleen and thymus and in the seminiferous epithelium is reported. A primary objective of the project is the determination of the effects of continuous low level irradiation on these kinetic parameters. Mice were used in all of the studies. Irradiations were performed using a ^{137}Cs source for the chronic exposures and a 240 kVp x-ray machine for the acute exposures. Cell proliferation kinetics were studied in lymphoid tissues of the normal thymus and spleen and in spleen germinal centers during antigenic stimulation. The effects of dose and dose rate on continuous irradiation effects, and the effects of continuous low level irradiation on lymphoid cell proliferation kinetics were studied. The accumulation of cellular radiation damage in lymphoid tissues under continuous low level irradiation was studied in relation to the effects on the regenerative capacity of the tissue. The kinetics of cellular proliferation and differentiation during radiation lymphomogenesis, and the effects of continuous low level irradiation on hematopoietic stem cell kinetics were also studied. The studies on seminiferous epithelium included the effects of continuous low level irradiation at 1.8 and 4.5 rads/day on cell proliferation in the seminiferous epithelium, and the kinetics of recovery and repopulation under continuous irradiation at 45 rads/day. A list of 76 scientific papers published during the reporting period is included. (E.R.B.)

43310 (COO-3380-2) TUMOR INCIDENCE IN RAT SKIN FOLLOWING PROTON IRRADIATION IN A SIEVE PATTERN. Burns, F. J.; Albert, R. E.; Bennett, P.; Sinclair, I. P. (New York Univ., N. Y. Inst. of Environmental Medicine). 1972. Contract AT(30-1)-2785. 28p. Dep. NTIS.

The dorsal skin of 183 male, albino rats was irradiated with 8.0 MeV protons at various doses in a uniform pattern and at two doses in sieve patterns with pore diameters of 5.0, 2.0, and 0.5 mm. The depth-dose curve of the proton beam was modified so that it was approximately linear with a maximum penetration of about 0.8 mm. Skin lesions were noted every 4 weeks for 80 weeks and at the end of the experiment were examined histologically. The results indicated that the sieve pattern did not significantly affect the tumor incidence per unit irradiated area or the incidence of damaged hair follicles at any pore size. This contrasts to the results of earlier experiments with electrons where a sieve pattern produced a significant protective effect at a pore diameter of 2.5 mm. Possible explanations for this discrepancy are discussed. (auth)

43311 (COO-3380-3) EFFECT OF FRACTIONATION ON TUMOR INDUCTION AND HAIR FOLLICLE DAMAGE IN RAT SKIN. Burns, F. J.; Albert, R. E.; Sinclair, I. P.; Bennett, P. (New York Univ., N. Y. Inst. of Environmental Medicine). 1972. Contract AT(11-1)-3380. 20p. Dep. NTIS.

Recovery with respect to tumor and atrophic follicle induction was measured in terms of the difference (D_2-D_1) between the fractionated dose (D_2) and the single dose (D_1) that produced equal effects. An initial electron dose of 750 rads was given to the dorsal skin of male, albino rats when the hair follicles were in the resting phase. Thirty-one days later, again in the resting phase, groups of previously irradiated rats and comparable unirradiated rats were given the following doses: 0, 750, 1500, 2250, and 3000 rads. The rats were observed every 4 weeks for 80 weeks. At 80 weeks all skin lesions were examined histologically, and the incidence of atrophic hair follicles was determined by observation of epithelial mounts. The values of D_2-D_1 for skin tumor induction and hair follicle atrophy were 650 rads and 700 rads respectively. (auth)

43312 (COO-3380-4) RADIATION-INDUCED HAIR FOLLICLE DAMAGE AND TUMOR FORMATION IN MOUSE AND RAT SKIN. Albert, R. E.; Burns, F. J.; Bennett, P. (New York Univ., N. Y. Inst. of Environmental Medicine). 1972. Contract AT-(11-1)-3380. 30p. Dep. NTIS.

The dorsal skin of 172 Swiss Millerton mice was irradiated with electrons in single exposures at six dose levels ranging from 500 to 4000 rads. The mice were observed every 4 weeks for skin tumor formation over a period of 88 weeks. At death, each tumor was examined histologically and whole skin mounts were used to determine the survival of intact hair follicles and the incidence of atrophic follicles. These data were compared to the dose-response characteristics for tumor induction and hair follicle survival in the rat from previous experiments. The incidence of epithelial skin tumors was markedly lower in mice compared to rats even at optimal tumorigenic doses. This difference was shown to be due to the failure of mice to develop adnexal tumors, which are the predominant type of skin tumor in the rat. The radiation sensitivity of the mouse skin for hair follicle destruction was at least double that of the rat. The virtual absence of atrophic follicle formation in the mouse skin as a consequence of radiation damage may be related to the failure to develop adnexal skin tumors, since there is a close association in the rat skin between the incidence of atrophic hair follicles and skin tumors. (auth)

43313 (ORO-3798-52) CHARGED PARTICLE IMPACT PHENOMENA FOR RADIOBIOLOGICAL APPLICATIONS. Progress Report. Green, Alex E. S. (Florida Univ., Gainesville. Dept. of Physics and Astronomy). 15 Jun 1972. 51p. Dep. NTIS.

Progress is reported in the microscopic approach to investigation of the underlying physical mechanisms in radiobiology. In this approach systematic studies of basic atomic molecular cross-sections and energy assignments are applied to energy deposition calculations of interest in radiobiology. Emphasis was placed on the spatial aspects and the biological aspects of the energy deposition problem. (C.H.)

43314 RELATIVE EFFECTIVENESS OF FISSION NEUTRONS FOR GASTROINTESTINAL DEATH IN MINIATURE PIGS. Jones, S. R.; George, R. E.; West, J. E.; Verrelli, D. M. (Armed Forces Radiobioloby Research Inst., Bethesda, Md.). Radiat. Res.; 50: No. 3, 504-18(Jun 1972).

Miniature pigs were bilaterally irradiated either in a neutron field (incident neutron to gamma ratio of 5) or in a gamma ray field (incident gamma to neutron ratio of 15) from the AFFRI-TRIGA reactor. For both fields the dose rate at the midline of the pigs was 250 rads/minute and uniform (class A) irradiations to the gastrointestinal (GI) tract were achieved. Midline tissue doses from the neutron field ranged from 360 to 1970 rads; survival times were from 3.6 to 11 days. Midline tissue doses from the gamma ray field ranged from 605 to 2630 rads and survival times from 4.4 to 11.1 days. Median lethal doses for GI death ($LD_{50(7.5)}$) were calculated to be 430 and 870 rads for the neutron and gamma ray fields, respectively. Relative effectiveness of the neutrons was 2.0. The ratio of the doses corresponding to 7.5 days mean survival time, calculated by the least-squares method, was used as an additional estimate of the neutron relative effectiveness. Results were in agreement with those of the $LD_{50(7.5)}$ method. Similar determinations for miniature pigs irradiated in the gamma ray field at 125 rads/minute showed no gamma ray dose rate dependence between 250 and 125 rads/minute. The relative segmental radiosensitivity of the GI tract and postirradiation bacterial proliferation in the miniature pigs are discussed. (auth)

43315 BLOOD CHANGES IN SHEEP AFTER ACUTE BETA IRRADIATION OF THE SKIN. Wade, Leo Jr.; Sasser, Lyle B. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Contract AT(40-1)-GEN-242. Radiat. Res.; 50: No. 3, 519-27 (Jun 1972).

Hematological studies and measurements of plasma iron concentration, plasma copper concentration, total iron-binding capacity, and total plasma protein were carried out in eight control sheep and eight sheep which received 25,000 rads of beta radiation to the skin. Thrombocytosis began at approximately 4 weeks postirradiation and persisted to approximately 18 weeks postirradiation. Lymphocytes and basophils in the irradiated sheep were significantly lower than in the control sheep while neutrophils and eosinophils were elevated beginning at approximately 8 weeks postirradiation. Mean corpuscular volume decreased and total red cell count increased in the irradiated sheep. Two periods of hypoferremia occurred in the irradiated sheep: one from 2 to 3 weeks and the other from 8 to 16 weeks postirradiation. Plasma copper concentration, total iron-binding capacity, and total plasma protein were significantly elevated in the irradiated sheep. (auth)

43316 CANINE INTESTINAL VASOACTIVITY DURING THE DEVELOPMENT OF THE GASTROINTESTINAL RADIATION SYNDROME. Kabal, John; Baum, Siegmund J.; Parkhurst, Louis J. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Radiat. Res.; 50: No. 3, 528-38(Jun 1972).

The functional vascular integrity of the canine small intestine was examined at 48 and 72 hours postirradiation. The dogs were exposed to 1500 rads midline tissue dose of mixed gamma-neutron radiation. First, the intestinal blood flow values of an in situ jejunal loop were measured in response to sudden systemic blood pressure alterations after exogenous administration of norepinephrine and isoproterenol. Second, the intestinal vasomotion was evaluated after applying a gradual bleeding and reinfusion technique. The regulation of the intestinal blood flow to sudden blood pressure changes, induced by the alpha and beta adrenergic agents, indicates progressive alterations in the neurohumoral vascular regulation during the postirradiation period. In the irradiated animals the so-called autoregulatory escape was not manifested after norepinephrine administration. The intestinal vessels of the irradiated dogs after 72 hours behaved as a rigid tube exhibiting an overshooting and a lack of vasocompensation components. The postirradiation vasoactivity during gradual blood volume alterations did not differ from the responses of the non-irradiated control group. The data indicate that intrinsic intestinal vascular alterations may underlie the development of the so-called gastrointestinal radiation syndrome. (auth)

43317 ROLE OF MUTATIONS IN LIVER TUMOR INDUCTION IN MICE. Curtis, Howard J.; Tilley, John (Brookhaven National Lab., Upton, N. Y.). Radiat. Res.; 50: No. 3, 539-42 (Jun 1972).

Liver tumors were induced in mice by neutron irradiation followed by a dose of CCl_4. The relation between tumor induction and neutron dose was found to be linear at low doses. This is interpreted to mean that although the tumor-induction process requires two or more independent events, only one of these can be considered a mutation. This result may or may not be applicable to other tumor systems. (auth)

43318 QUANTITATIVE CHARACTERISTICS OF CONNECTIVE TISSUE CELLS AND BLOOD VESSELS OF A SKIN WOUND AND OF SUBCUTANEOUS CELLULAR TISSUE IN ACUTE RADIATION SICKNESS. Smirnov, E. A. (Pushkin Central Regional Hospital, USSR). Med. Radiol.; 16: No. 12, 56-61(Dec 1971). (In Russian).

White rats were given 700 R of whole-body gamma radiation and the formation of young macrophages and fibroblasts, and of blood vessels in loose connecting skin was observed. The essential difference of these processes was noted only during a period of the climax of radiation sickness. This could assist in the determination of operative procedures for persons affected by radiation. (tr-auth)

43319 ULTRASTRUCTURE OF BLOOD PLATELETS AT THE PERIOD OF ACUTE RADIATION SICKNESS AND AT REMOTE PERIODS AFTER IRRADIATION. Nestaiko, G. V.; Kurilets, E. S.; Gracheva, A. I. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 16: No. 12, 50-5 (Dec 1971). (In Russian).

On Chinchilla rabbits irradiated with a dose of 600 R, it is shown that ultrastructural changes of blood platelets during acute radiation sickness and at remote periods after radiation are of a diverse character. In acute radiation sickness, thrombocytes change in relation to the number of organelles seen (a decrease of 5-OT-organelles and an increase in the number of alpha-granules). At the remote postradiation period (2, 3, 4, and 6 months), there is a characteristic appearance of a large quantity of vacuoles and an unusual accumulation of glycogen granules. Changes of the electron microscopic picture of blood platelets are, apparently, associated with a disturbance of thrombocytopoiesis. (auth)

43320 SUBCUTANEOUS ADMINISTRATION OF BONE MARROW IN ACUTE RADIATION SICKNESS. Golubeva, L. A.; Zaitseva, K. K.; Butomo, N. V. (Air Force Medical Academy, Leningrad). Med. Radiol.; 16: No. 12, 44-9(Dec 1971). (In Russian).

It is shown that subcutaneous administration of bone marrow to dogs irradiated with doses close to absolutely lethal ones produces a marked curative effect. In irradiated recipients, the myeloid cells are found at the site of injection for a longer time than in nonirradiated animals. A supposition is set forth that in irradiated dogs the transplanted young myeloid cells in the process of their differentiation secrete a substance that exerts a stimulating humoral influence on the restoration of hematopoiesis in the recipient. (auth)

43321 RELATIVE EFFECTIVENESS OF LOW LEVELS OF RADIATION IN INDUCING GENETIC DAMAGE IN MICE. Russell, W. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 65(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43322 MECHANISMS OF RADIATION DAMAGE AND REPAIR IN HUMAN AND OTHER MAMMALIAN CELLS. Cleaver, James E. (Univ. of California, San Francisco). Trans. Amer. Nucl. Soc.; 15: No. 1, 450(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43323 DISAPPEARANCE RATES OF RADIATION-INDUCED CHROMOSOME ABERRATIONS FROM SWINE LEUKOCYTES. McFee, A. F.; Banner, M. W.; Sherrill, Mary N.; Mailhes, John B. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Mutat. Res.; 15: No. 3, 325-30(Jul 1972).

Whole-blood leukocyte cultures were evaluated at intervals up to 20 weeks following the exposure of mature pigs to 150 or 200 R whole-body doses of γ radiation. Lymphocyte number was depressed to approximately 35% of preirradiation values by 48 h postexposure: chromosome aberration levels also fell quite drastically during this period. A rapid decrease in aberrations per cell indicated selective removal of cells containing chromosome anomalies during the early postirradiation period. Elevated levels of both one-track and two-track aberrations persisted at 20 weeks although the former had been at preirradiation levels at 12 and 16 weeks. (auth)

43324 DETERMINATION OF THE RADIATION-INDUCED MUTATION RATE FOR SEX-LINKED LETHALS AND DETRIMENTALS IN THE MOUSE. Grahn, Douglas; Leslie, Wayne P.; Verley, Frank A.; Lea, Ruth Ann (Argonne National Lab., Ill.). Mutat. Res.; 15: No. 3, 331-47(Jul 1972).

A 3-generation screening procedure has been employed for the detection of sex-linked lethals and detrimentals in the mouse following a single high-intensity exposure of the spermatogonia to 500 R. The Tortoise (To) mutant, which is male-lethal, was used as a marker for the unirradiated X in the F_1 to eliminate XO mice, to improve the efficiency of detecting a significant sex ratio change and to serve as the point marker for calculations of the radius swept for new lethals. Each F_1 dam under consideration was accepted or rejected as a presumed carrier on the basis of the number of males in family sizes between 10 and 30. The decision criteria were determined with the use of Haldane's swept-radius mathematics to establish type-I error terms of 10% and 35% and a variable type-II error. The F_1 data gave evidence of sex-linked prenatal dominant lethals, though the rate, $1.3 \cdot 10^{-4}$/R/X, was not significant. The 2nd generation gave significant evidence for the induction of both prenatal sex-linked recessive lethals and detrimentals and postnatal genomic detrimentals manifest in the heterozygote. The estimated rates are $8.5 \cdot 10^{-5}$/R/X and $3.7 \cdot 10^{-5}$/R/grandsire's genome, respectively. It was not possible to isolate genetically any of the presumed sex-linked lethals, though their existence does seem substantiated by the concurrent reduction of litter size in the suspect-carrier families. These 2nd generation data are discussed in relation to other studies that have attempted to define the sex-linked recessive lethal mutation rate and the induction of recessive detrimentals. It is concluded that the mammalian X-chromosome may have different properties than the autosomes regarding the survival of a lethal event, and the difficulties in the detection of recessive detrimentals seem to be due to both choice of endpoint and sampling statistics. The probability of heterozygous expression of a presumed detrimental is estimated from these data to be less than 5%. (auth)

43325 POST-RADIATION STRUCTURAL ALTERATIONS IN THE ARTICULAR CARTILAGE. Zedgenidze, G. A.; Modyaev, V. P.; Gulyaev, V. A.; Ankina, M. A. (Inst. of Medical Radiology, Moscow). Med. Radiol.; 17: No. 3, 3-10(Mar 1972). (In Russian).

Histological and electron-microscopic findings concerned with alterations and reconstruction of the articular cartilage tissue in adult rabbits following a single local γ irradiation in a dose of 900 rad are set forth. External cellular zones of the tissue—transitional and isogenic groups—proved most sensitive to the action of ionizing radiation. First morphological signs of radiation reaction were noted already during the first 24 hrs and peaked on the 14 to 17th day. At the root of cellular changes lies disorganization of their internal structure. The period of tissue reconstruction lasts from 14 to 30 days (and, apparently even longer) and is characterized by a set of reparative reactions developing pre-eminently in the same superior sections. The exposed data are original. (auth)

43326 EVALUATION OF THE LIVER SENSITIVITY TO WHOLE-BODY IRRADIATION. Zakharieva, Z.; Byrzeva, L. (Advanced Medical Inst., Plovdiv, Bulgaria). Med. Radiol.; 17: No. 3, 58-64(Mar 1972). (In Russian).

Experiments were conducted on six rabbits (males and females) subjected to γ irradiation with a single dose of 1000 R, and on seven other rabbits receiving for 1 min a dose of 25 R over a total period of 30 days. The liver was found to become implicated in the pathological process in animals of both groups, with alterations therein being of a phasic nature. The protein synthetic function was upset in a subchronic experiment in which the quantity of total protein diminished at the expense of albumins and a compensatory increase of γ-globulins in the serum of test animals. The serum cholinesterase activity diminished in both types of irradiation. The transaminase activity was distinguished by its phasic nature, while the β-lipoproteins content changed under a more intensive effect of radiation, this, however, manifesting itself after a definite period of time. The fixation and excretory function of the liver became affected under a more protracted action exerted by lower doses. (auth)

43327 EFFECT OF LOW-ENERGY β RADIATION ON THE SORPTIVE PROPERTIES OF THE SKIN. Mirtov, A. V.; Rappoport, I. A.; Taratukhin, V. R. Med. Radiol.; 17: No. 3, 64-6 (Mar 1972). (In Russian).

Animal tests using rats demonstrated that soft ^{133}Xe β-radiation in doses of 6.0, 9.4, and 14.7 rad did not produce any statistically significant shifts in the sorptive properties of the skin. The mentioned doses did not lead to the development of clinical symptoms pointing to the lesion of irradiated areas of the skin. (auth)

43328 EFFECT OF PHYTOHEMAGGLUTININ ON HEMATOPOIETIC DEPRESSION PRODUCED BY RADIATION. Lopez, Amado; Lozzio, Bismarck B. (Univ. of Tennessee, Knoxville). Exp. Hematol.; 22: No. 1, 90-3(Mar 1972).

Mice were x-irradiated at 750 R and given intraperitoneal injections of phytohemagglutinin; controls were given inactivated phytohemagglutinin or saline. Nine days after irradiation the mice were killed and the spleen colonies were counted. Studies were also conducted on ^{59}Fe uptake by the skeleton, spleen, blood, and liver. Results indicated that administration of phytohemagglutinin after irradiation enhanced hematopoietic recovery of sublethally irradiated mice as judged by an increased number of endogenous spleen colonies and stimulation of marrow and splenic erythropoiesis. Hematopoiesis of irradiated animals was enhanced only when the same dose of phytohemagglutinin was given immediately and two days after irradiation. Possible mechanisms by which the administration of phytohemagglutinin stimulates hematopoietic regeneration are discussed. (H.L.W.)

43329 CHANGES IN PROTEIN BIOPOLYMERS OF TISSUE, PRODUCED BY FRACTIONAL X-IRRADIATION, AND THEIR TRANSFORMATION AFTER ADRENALECTOMY AND SUBSTITUTING HORMONE THERAPY. Famichenka, K. V.; Petrusenka, G. P. (Inst. of Physiology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 2, 47-52(1972). (In Belorussian).

The composition of predominant protein polymers in liver and brain tissue was investigated following fractional x irradiation in 40 R doses (3 × 13.3 R). A similar pattern of irradiation of animals with removed adrenal glands and animals with substituted hormone therapy revealed a difference in post-radiation effects in the protein exchange of the two tissues. A neuroendocrine dependence of separate types on metabolic changes at the tissue-organ level is postulated. (tr-auth)

43330 MORPHOLOGICAL CHANGES OF THE SKIN DURING DEVELOPMENT OF ACUTE RADIATION ULCERS (HISTOLOGICAL AND ELECTRON MICROSCOPIC EXAMINATION). Sasnouski, A. Ts.; Syarzhanina, A. M. (Minsk Medical Inst.). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 2, 83-8(1972). (In Belorussian).

The morphological picture of the skin of rabbits irradiated locally by x rays was examined using light and electron microscopes during the development of acute radiation ulcers. Skin changes were noted soon after the radiation treatment (distropic processes, necrosis of the epidermis, follicular epithelia, surface layers of the dermis, disrupted vascular reactions). Exudative, inflammatory reactions in thick dermis, with necrosis of the tissue were manifest as secondary reactions. Damage to the plasmatic membranes and the mitochondrial membranes in cells of the epidermis and in the fibroblasts was established. Nuclear and intra-cytoplasmatic edema and a change in the distribution of the granules of the chromatin in the nucleoplasm and ribonucleoprotein granules in the cytoplasm of epidermal cells were also observed with the electron microscope. With an increased period after irradiation the seriousness of the injury to the cell ultrastructure was enhanced. (tr-auth)

43331 COMPARATIVE STUDY OF THE BIOLOGICAL EFFECTS OF X RAYS AND OF MUSTARD GAS (β,β′-DICHLORODIETHYLSULFIDE) ON THE THYMUS OF YOUNG RATS. Catalini, Nicola; Gibertini, Giancarlo; Margotta, Vito; Filoni, Sergio (Univ., Rome). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 51: No. 1-2, 86-92(1971). (In Italian).

The biological effects of x rays and sulfur mustard on the thymus of young rats were compared. The results are summarized as follows: After x irradiation, the thymus presents a remarkably altered histological picture (high percentage of picnotic lymphocytes, mitotic inhibition, and alteration of the cortico-medullary boundary) but it has a rather rapid recovery with a maximum of the mitotic activity at the 5th day after irradiation. Treatment with sulfur mustard caused delayed histological injuries and a lowered mitotic activity with a minimum at the 5th day; the recovery was also gradual and slow. It was concluded that even if there is a certain degree of analogy between x rays and sulfur mustard concerning their histological effects, they have a different mechanism of action. (auth)

43332 ANDROBLASTOMAS OF THE OVARIES INDUCED BY PENETRATING RADIATION. Gubareva, A. V. (Central Scientific-Research Rentgeno-Radiological Inst., Leningrad). Arkh. Patol.; 34: No. 5, 17-21(1972). (In Russian).

The morphological structure of eight androblastomas of the ovaries in mice (two sertolioma of the type of testicular tubular adenoma, and six androblastomas of intermediate type) induced by penetrating radiation are described in detail. The author held that origination of androblastomas in the irradiated mice was associated with both elements of the ovary cover (more exactly, with immersed ducts that are inseparable from sterilized gonads) and the ovary net. There is also a likelihood of their development out of the medullary ligaments. (auth)

43333 VIETNAMESE MINIATURE SWINE IN RADIATION BIOLOGY. **Mittendorf, F.; Morczek, A.; Schmidt, W. (Medizinische Akademie, Magdeburg, Ger.). Z. Versuchstierk.; 13: No. 1, 7-16(1971). (In German).**

The progress of acute radiation syndrome in Vietnam miniature swine after a single whole-body exposure with a mean surface dose of 300 R, 400 R, 500 R, or 600 R was studied. The $LD_{50/30}$ was 400 R. The symptoms, hematological reactions, and the cause of death were similar to those caused by an average exposure dose in humans. It is believed that the Vietnam miniature swine are a suitable model for experimental radiobiology. (auth)

43334 EFFECTS OF PHYTOHAEMAGGLUTININ ON THE IMMUNE RESPONSE OF IRRADIATED RABBITS. **Kutas, Vera; Meretey, Katalin; Elekes, Eizsebet; Kocsar, L. (National Research Inst. for Radiology and Radiohygiene, Budapest). Haematologia (Budapest); 4: No. 3-4, 379-83(1970).**

Phytohaemagglutinin injected before primary antigenic stimulation was found to increase secondary antibody production against sheep red blood cells in rabbits. This effect was practically abolished by x-ray irradiation and appeared in a slight form in rabbits irradiated before secondary antigenic stimulation. (auth)

43335 SOME OBSERVATIONS ON MELANIN SYNTHESIS ANOMALIES IN MOUSE HAIR FOLLICLES AFTER TREATMENT WITH X-RAYS OR ACTINOMYCIN D. **Potten, Christopher S. (Allegheny General Hospital, Pittsburgh). Radiat. Res.; 51: No. 1, 167-89(Jul 1972).**

The response of mouse hair follicle melanocytes in four distinct phases of their life cycle, to x rays or actinomycin D, has been studied. X rays were found to have a destructive effect on both G_0 and dividing amelanotic melanocytes, while actinomycin D appeared to have no effect. For melanocytes nearing the end of the division phase and the beginning of the melanogenic phase, x rays are still destructive; however, the sensitivity at this stage is less than when the cells are dividing. Actinomycin D produces growing follicle pigmented cell distribution abnormalities when given to follicles containing melanocytes at the end of their dividing phase. These pigment abnormalities are characteristically scattered throughout the follicle in both the upper external sheath regions and the lower follicle bulb. Both x rays and actinomycin D cause growing pigmented hair follicles to show gross abnormalities of lower follicle pigmented cell distribution. The growing follicle, nine days after plucking, is very sensitive to treatments with either agent. Pigmented cells are seen at abnormal locations 24 to 72 h after doses of 25 rads of x rays or 25 μg/kg of actinomycin D. Some speculations are made regarding the local concentration of actinomycin after subcutaneous and intraperitoneal injections. The mechanisms involved in the pigment abnormalities are discussed with particular reference to gene derepression. (auth)

43336 STUDY OF THE SALIVARY GLAND FUNCTIONAL INHIBITION BY USE OF ^{99m}Tc-PERTECHNETATE. RADIATION INJURY OF SALIVARY GLANDS. **Suda, Yoshinori (Nippon Dental Coll., Tokyo). Shigaku; 59: No. 1, 1-12(Apr 1971). (In Japanese).**

Technetium, like iodide, a member of the VIIth periodic group, has some biological similarities to iodide and is trapped by the salivary glands. Technetium-99m pertechnetate ($^{99m}TcO_4^-$ is an ideal tracing agent because of its physiological properties: short half-life, no β-ray emitting, and low γ-ray energy. The uptake of $^{99m}TcO_4^-$ by the salivary glands of rabbits at various times and the relation between the uptake of $^{99m}TcO_4{}^-$ and the pathological changes caused by ^{60}Co γ-ray 5000 rad irradiation in parotid glands of rabbits were studied. Uptake curves for both parotid and submaxillary glands have two peaks at 30 min and 3 hrs after injection. The higher peaks are observed at 3 hrs after injection in both salivary glands. Parotid glands showed higher $^{99m}TcO_4^-$ uptake than submaxillary glands during the observation time. The highest peak was observed after 3 hrs in the parotid gland. Uptake of $^{99m}TcO_4^-$ showed low values when functional inhibition by radiation was considered histopathologically in the parotid glands. (auth)

43337 EXPERIMENTAL STUDY ON PHARMACOLOGICAL EFFECT TO IRRADIATED MICE. 1. EFFECT OF INOSINE. **Hattori, Yukiyoshi (Kagoshima City Hospital, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 1, 17-24(Apr 1971). (In Japanese).**

The effect of inosine on survival rate and body weight of irradiated mice was studied. Mice were given 600 R of whole-body x irradiation and on each day of the following 7 days, they were given subcutaneous injections of inosine. Its quantity varied from 0.01 mg to 1.0 mg per 0.1 cc according to the group. The survival rate of the mice with no inosine was 10% and their LD_{50} was 12 days. The groups of mice with 0.01 mg to 0.5 mg of inosine showed an apparent recovery with increase of survival rate and body weight. With the use of 1.0 mg of inosine, no recovery was observed at all and 1.0 mg of inosine showed no influence on nonirradiated mice. From the above observation it was concluded that the proper amount of inosine to use was from 0.01 mg to 0.5 mg when 600 R was the radiation dose. (auth)

43338 RADIOSENSITIVITY OF MAMMALIAN CELLS. 4. CHANGE OF DNA CONTENT IN NUCLEI OF RAT SOMATIC CELLS AFTER IRRADITATION. **Kobayashi, Jindo (Tokushima Univ., Japan). Tokushima J. Exp. Med.; 17: 47-55(Nov 1970).**

Experiments were carried out with 7 days old rat embryos (Wistar strain). The animals received whole body irradiation at a dose of 500 R. Samples of brain, liver and kidney tissue were taken 5, 10, 15, 20 and 25 hours after exposure and fixed in Carnoy's solution for 10 minutes. The DNA contents of individual nuclei were measured at 5220 A with a spectrophotometer by the single wave length method. The DNA contents of 60 interphase nuclei were measured and results are given as the mean total DNA content with the standard deviation in arbitrary units. The average cell volume was also measured. Changes of the DNA content in liver, kidney and brain nuclei of rat embryos after irradiation with 500 R were investigated by microspectrophotometry. In all these tissues decreased DNA contents were observed after irradiation. Results suggested that the decrease of DNA content in these somatic cells was due to physicochemical changes of Feulgen-positive DNA in nucleoproteins. (Japan)

43339 EFFECT OF HYPOXIA ON X-RAY RADIATION DAMAGE TO THE GROWTH ZONE OF THE RADIUS IN RABBITS. **Olerud, B.; Olerud, S. Acta Soc. Med. Upsal.; 76: No. 1-2, 1-9(1971).**

The effects of x radiation on the growth zone of the radius of rabbits were compared at different oxygen tensions. In extremities exposed to x radiation in the conventional way, changes occurred after different times. When hypoxia was induced in the extremity by application of a tourniquet for 10 min combined with a 6 min period of radiation, only minimal changes occurred in the growth zone. No appreciable difference was observed in the histological appearance of the bone growth zone between cases exposed to x radiation during tourniquet-induced hypoxia and cases not exposed to radiation. (Sweden)

43340 EFFECTS OF NEGATIVE ELECTROSTATIC POTENTIAL LOADING ON RADIATION INJURIES. 1. EXPERIMENTAL STUDIES ON MICE. **Hirofuji, Michio (Izu Teishin Hospital, Shizuoka, Japan). Nippon Onsen Kiko Butsuri Igakkai Zasshi; 34: No. 3-4, 109-14(Mar 1971). (In Japanese).**

Two groups of mice (ddN-strain) were used, of which one was exposed to a large x-ray dose in a single exposure and another was exposed to the same dose in a fractionated exposure in order to determine the relation between the effects and irradiation method. The survival curves for 900 R and 700 R irradiations in a single exposure showed no significant difference between the treated group and the control. For the fractionated exposure in which a dose of 1,000 R was given divided into ten exposures on every other day, the survivals of the treated group surpassed those of the control below 700 R, and above 1,000 R the survival curve of the treated group gradually approached close to those of the control. By the fractional exposure in which a total dose of 600 R was divided into twenty exposures, six exposures per week, the white blood cell count of both groups decreased to the minimum at about 300 R (about 9,000 for the treated group and about 5,000 for the control), and above 600 R, the leukocyte counts of the treated group recovered at about five weeks later to almost the same level as those before irradiation, but on the contrary the control group showed no such recovery. Moreover, concerning the histological findings of the bone marrow in the femur and sternum, the spleen, and the lymph nodes, it was revealed that the radiation injury of the treated group was less than that of the control, and the recovery of the injury after irradiation in the treated group was better than that of the control. (auth)

43341 DEVELOPMENT AND RADIORESPONSE OF THE PRENATAL BOVINE TESTIS. **Matschke, G. H.; Erickson, B. H. (Univ. of Tennessee, Oak Ridge). Biol. Reprod.; 1: 207-14(1969).**

Prenatal development of the bovine testis and its germ cells was observed in gonads or testes that varied in age from 27 to 280 days postcoitum. Germ cells per testis increased from few or no germ cells at day 32 (germinal ridge first noted) to 4.1 million at day 110. Numbers remained essentially unchanged from this age to day 200, but from this point to day 270 numbers of germ cells rose to approximately 13.4 million. Germinal mitotic activity was at a peak in testes aged 37 days, remained high to day 55, dropped abruptly at day 65 and decreased to its lowest level at day 110. Mitotic activity increased somewhat in testes of 230 days of age and by day 270 numbers of mitotic figures were approximately double that seen at day 230. Fifty-six animals were exposed in utero (400 R, air dose to dam) to approximately 150 rads of ^{60}Co gamma rays at 0.5 R/min. Ages at irradiation varied from 20 to 280 days postcoitum. Histological analyses of testes aged 10 months revealed little or no damage in those irradiated prior to day 70 of gestation, but at day 70, 70% of the tubule cross-sections examined were sterile. The percentage of sterile cross-sections increased slightly in testes irradiated at days 91 to 120 and remained unchanged to day 210. Thereafter, the magnitude of the irradiation effect diminished and only 20% of the tubule cross-sections were sterile in testes irradiated at 241 to 280 days of gestation. Sperm of lesser quality was produced by bulls 25 months of age irradiated at 130 days of gestation at 30% of control levels. (auth)

43342 EFFECT OF ^{60}Co GAMMA RADIATION DOSE RATE ON 30-DAY MORTALITY IN SWINE. **Brown, Daniel G.; Cross, Fannie H.; Gramly, Warren A. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. Amer. J. Vet. Res.; 33: No. 5, 957-62(May 1972).**

One hundred and sixty-three 8-month-old Duroc swine that averaged 114 kg in body weight were exposed to ^{60}Co gamma radiation. Radiation doses were given at rates of 1, 10, and 50 rads per min. The clinical syndrome and 30-day mortality were studied. The median lethal doses causing 30-day mortality ($LD_{50/30}$) in swine subjected to dose rates of 1, 10, and 50 rads per min were 710, 435, and 360 rads (tissue doses in air), respectively. Mean survival time for all decedents was 16 days, with the earliest death occurring at 9 days and latest death at 30 days after irradiation. Although dose rate significantly affected the dose-mortality curves, it did not affect survival time or the general clinical syndrome. The relative effectiveness of 10 rads per min and that of 50 rads per min in causing 30-day mortality were 1.63 and 1.97, respectively, where 1 rad per min was assigned the value of 1. The higher dose rates were also more effective in causing decrease of leukocyte and platelet concentrations in the peripheral blood. (auth)

43343 IRRADIATION PROTECTION OF DOGS WITH LONG-TERM STORED BONE MARROW. Malinin, Theodore I.; Brodine, Charles E. (National Naval Medical Center, Bethesda, Md.). Exp. Hematol.; 22: No. 1, 47-8(Mar 1972).

Bone marrow was collected by aspiration of ribs and long bones of beagles and prepared for storage by freezing; the frozen marrow was stored in liquid nitrogen for up to three years. At the end of the storage period the animal from which it was obtained received 700 R whole-body x radiation and thawed bone marrow was injected intravenously into the original donor 24 hrs following radiation exposure. Control animals were irradiated but did not receive bone marrow. The 13 control animals died between 10 and 21 days post-irradiation; of the 15 animals treated with stored bone marrow, 12 survived two months or more. Results demonstrated the practicality of long-term storage of bone marrow at liquid nitrogen temperatures. (H.L.W.)

43344 RADIOSENSITIVITY OF THE PERITONEAL MONONUCLEAR PHAGOCYTES AND THEIR PRECURSOR CELLS. **Harper, J. R.; Wolf, N. S. (Univ. of Washington, Seattle). Exp. Hematol.; 22: No. 1, 84(Mar 1972).**

The accrual of intraperitoneal macrophages in the peritoneal cavity of mice following stimulation with sterile thioglycolate broth was found to be due entirely to immigration of cells from outside the peritoneal cavity, as determined by a complete absence of mitosis at any time among the intraperitoneal population. X irradiation at doses of 500 and 1000 R given 24 hrs previous to the stimulation reduced the number of cells collected from the peritoneal cavity to that of the unstimulated controls. Similar irradiations given 24 hrs post-stimulation had little or no effect under otherwise similar circumstances. (H.L.W.)

43345 POSTCONCEPTION DEVELOPMENT OF RAT OVA FOLLOWING X-RAY INDUCED SUPEROVULATION. Feingold, Stephen M.; Hahn, Eric W. (Sloan-Kettering Inst. for Cancer Research, New York). Radiat. Res.; 51: No. 1, 110-20(Jul 1972).

Prefertilization x-irradiation of Long-Evans rats induces an exposure dependent increase in ovulations, implantations, and live term fetuses. However, the pre- and postimplantation losses are also dependent on the level of radiation. The early development of superovulated ova, induced by x-irradiation, was examined to elucidate the nature of pre- and postimplantation losses. Long-Evans rats were given 0, 200 and 400 R x-irradiation 4 days before mating. Ova were examined microscopically on days 0.5 and 3.5 of pregnancy. Corpora lutea, implantations and live term fetuses were examined on day 20.5 of pregnancy. After 400 R, fertilization is decreased. After 200 and 400 R, there was an increased degeneration of tubal embryos at day 3.5 of pregnancy. These factors may account for the preimplantation losses, however, another factor involved may be the formation of corpora lutea from unovulated follicles. Radiation also induced a significant mitotic delay in tubal embryos. Both the number of embryos delayed and the extent of the delay increased with the level of irradiation. The observed mitotic delay appears unique because it is manifest days after the time of irradiation. (auth)

43346 BONE MARROW REGENERATION IN GERMFREE NO-2 MICE AFTER 700 RAD WHOLE BODY IRRADIATION. Heit, H.; Fliedner, T. M.; Fache, I. (Univ., Ulm, Ger.). Radiat. Res.; 51: No. 1, 72-83(Jul 1972).

The purpose of this experiment was to compare the pattern of hemopoietic regeneration following bone marrow aplasia in conventional and germfree ND_2 mice after 700 rads whole body x-ray exposure. All conventional mice died of the consequences of pancytopenia, i.e., bleeding and infection, within 10 to 12 days postirradiation. In these animals, no sign of bone marrow restoration could be detected; however, a limited amount of hemopoietic recovery was seen in the spleen. In contrast, about 40% of the germfree mice survived the first 12 days of postexposure. Quantitative cyto- and histomorphological studies of the blood, bone marrow and spleen provided evidence of a progressive hemopoietic recovery which could be followed in some of the animals for more than 20 days postirradiation. The first evidence of erythro- and megakaryocytopoietic regeneration in the bone marrow was observed at days 10 and 16, respectively, postirradiation. Blood erythrocyte and platelet counts began to rise between days 15 and 18. However, no signs of myelopoietic recovery were seen within the first 3 weeks postirradiation. Endogenous spleen colonies appeared between days 12 and 16 in the germfree mice. The nodules consisted mainly of erythropoietic tissue; however some were found to contain megakaryocytic and myelopoietic cells as well. Possible reasons for the differences in the response of germfree and conventional animals to irradiation are discussed. (auth)

43347 ATTEMPTS AT RESTORATION OF IRRADIATED MICE WITH INJECTIONS OF DNA. Charles, P.; Ledoux, L.; Maisin, J. R.; Mattelin, G.; Remy, J. (CEEN, Mol, Belg.). Arch. Int. Physiol. Biochim.; 79: No. 4, 822-3(Oct 1971).

Two strains of mice were x-irradiated with doses of 550 to 800 R and dose rates of 10 R/min and 100 R/min. DNA of different origins was injected intraperitoneally after irradiation. Analysis of results showed that the restorative effect of a given DNA depended on the strain, the dose rate, and the total dose. (H.L.W.)

43348 DYNAMICS OF THE EMBRYONAL MOUSE BRAIN PROLIFERATION FOLLOWING FRACTIONATED X-RAY IRRADIATION. AUTORADIOGRAPHIC STUDIES. Saebisch, R. (Univ., Tuebingen, Ger.). Virchows Arch., B; 8: No. 1, 50-7 (1971). (In German).

The kinetics of cells of the embryonal mouse brain following fractionated x-ray irradiation were studied by incorporation of triated thymidine. The mice were irradiated on the 11th, 12th and 13th day of pregnancy with 60 R. Microscopically no inhibition of DNA synthesis was seen. The time of mitoses was normal. Neither a reduction of mitoses nor cell death was found. The results suggest a limit of x-ray tolerance. (auth)

43349 INVESTIGATION ON THE HYALURONIDASE ACTIVITY IN POST-RADIATION SICKNESS. **Kocmierska-Grodzka, D. (Pharmacological Inst., Bialystok, Poland). Radiobiol.-Radiother.; 12: No. 6, 757-63(1971).**

X irradiation of rats with 600 R evokes, 24 hours after exposure, an increase in hyaluronidase activity in serum, spleen, intestine, and liver. The application of antiproteolytics (EACA, Iniprol) in animals before and after irradiation caused a decrease in the enzyme activity in some investigated tissues. Under the influence of Iniprol there is a decrease in splenic hyaluronidase activity in the control group. The release of hyaluronidase activity from the incubated liver lysosomes was greater in the irradiated animals (800 R) than in the control group or groups protected by EACA and Iniprol. (auth)

Invertebrates

43350 DOSAGES OF GAMMA IRRADIATION FOR FULL AND INHERITED STERILITY IN ADULT PINK BOLLWORMS. Graham, H. M.; Ouye, M. T.; Garcia, R. D.; de la Rosa, H. H. (Entomology Research Div., Brownsville, Tex.). J. Econ. Entomol.; 65: No. 3, 645-50(Jun 1972).

Newly emerged adult Pectinophora gossypiella (Saunders), when exposed to 25 or more krad of gamma irradiation and allowed to mate with untreated insects of the opposite sex, produced no fertile adult progeny. First- and 2nd-filial-generation adults from adults treated with 5 to 18 krad exhibited varying degrees of sterility. This feature was not so pronounced in the 3rd-filial-generation adults. Irradiation of mated females at 10 to 30 krad gave results similar to those of matings of males and females irradiated at these dosages prior to their mating. (auth)

43351 RADIATION SENSITIVITY OF SUCCESSIVELY IRRADIATED GENERATIONS OF THE INDIAN MEAL MOTH. Hossain, Mir M.; Brower, John H.; Tilton, Elvin W. (Dept. of Agriculture, Savannah). J. Econ. Entomol.; 65: No. 3, 673-6(Jun 1972).

Five populations of Plodia interpunctella (Hübner) were treated, respectively, with 0 (control), 0.5, 1, 2, and 4 krad of gamma radiation in each generation. Groups of 7th-generation adults were then tested for resistance to acute irradiation by exposing them to total doses of 16 and 50 krad. Unirradiated 8th-generation adults from each population were checked for mating success and fecundity. No evidence of increased resistance to acute radiation exposures was found. Treated populations showed slight but not significant decreases in mean survival time. A general reduction in fecundity and in percentage of successful matings in the treated populations with greater radiation pressures also indicated a decrease in population fitness. Therefore, the possibility of accidental exposure of some insects to substerilizing dosages during commercial radiation disinfestation does not appear to be a serious problem. (auth)

43352 EFFECTS OF GAMMA RAYS ON THE ACUTE LETHALITY AND REPRODUCTIVE POTENTIAL OF LESSER GRAIN BORER ADULTS. Singh, H.; Liles, J. N. (Univ. of Tennessee, Knoxville). J. Econ. Entomol.; 65: No. 3, 656-9(Jun 1972).

The acute lethality and reproductive potential of one-week-old adult Rhyzopertha dominica (F.) were determined at various exposures ranging between 5 and 320 kR of gamma rays. Observations revealed that exposure of 320 kR killed all the beetles during irradiation. Treatments of 20 kR or greater produced 100% mortality within 4 to 25 days, depending on the exposure. Beetles surviving the 5 kR exposure for the 1st 30-day-posttreatment period lived as long as the controls. The exposure of 5 kR or greater resulted in the permanent sterility of both sexes of the beetles. Practical and radiobiological implications of the findings are discussed. (auth)

43353 LONGEVITY AND REPRODUCTION OF CODLING MOTHS IRRADIATED WITH ^{60}Co OR ^{137}Cs. White, L. D. (Entomology Research Div., Yakima, Wash.); Kamasaki, H.; Ralston, D. F.; (and others). J. Econ. Entomol.; 65: No. 3, 692-7(Jun 1972).

. Adult Laspeyresia pomonella (L.) were treated with ^{60}Co (Yakima, Washington) and ^{137}Cs (Vincennes, Indiana) at levels of 10, 15, 25, and 40 krad and evaluated by five criteria, male longevity, female longevity, mating, oviposition, and egg hatch. When a sterilizing dose of 25 krad was given to males only, the effects of cobalt on mating and egg hatch were significantly different from the effects of cesium; however, at a dose of 40 krad, only the frequency of mating on the basis of the five criteria was significantly different. The mating combinations (treated × untreated insects) and the doses significantly affected the moths compared with the untreated controls, regardless of source. Also, though some of the differences in the responses were real between the two sources and locations, the trends were similar, and both types of treatments effectively sterilized the adult codling moth. (auth)

43354 BULK-GRAIN GAMMA IRRADIATION FOR CONTROL OF INSECTS INFESTING WHEAT. Cogburn, Robert R.; Tilton, Elvin W.; Brower, John H. (Dept. of Agriculture, Savannah). J. Econ. Entomol.; 65: No. 3, 818-21(Jun 1972).

A bulk-grain irradiator was used to treat 122 metric tons (5000 bu) of insect-infested wheat to determine the feasibility of the operation. The wheat was heavily infested with rice weevils, Sitophilus oryzae (L.); lesser grain borers, Rhyzopertha dominica (F.); and flat grain beetles, Cryptolestes spp. Dosages tested were a low dose that averaged 27.4 krad and a high dose that averaged 41.2 krad. Abundance of all three species was greatly reduced by both dosage levels, and control was judged to be satisfactory. However, much of the initial insect population was destroyed by mechanical handling during treatment, and reinfestation of the wheat from outside sources occurred. (auth)

43355 LONGEVITY AND SEXUAL ACTIVITY OF NEWLY ECLOSED IRRADIATED SCREWWORM FLIES HELD AT IMMOBILIZING LOW TEMPERATURES. Hightower, B. G.; Garcia, Jose J. (Dept. of Agriculture, Mission, Tex.). J. Econ. Entomol.; 65: No. 3, 877-8(Jun 1972).

Screwworm flies (Cochliomyia hominivorax) were exposed as pupae to 7500 R of γ irradiation and then within 4 hr after eclosion were exposed to low temperatures in a bioclimatic cabinet. The mean life span, time to sexual maturity, and mating frequency of flies exposed to 1°C or 6°C for various periods of time were determined. From the results, it was concluded that the immobilization of flies by low temperatures could improve the effectiveness of γ eradication. (E.R.B.)

43356 EFFECTS OF IRRADIATION ON ABILITY OF ADULT MALE CORN EARWORMS TO TRANSFER SPERM, AND FIELD ATTRACTIVENESS OF FEMALES MATED TO IRRADIATED MALES. Snow, J. Wendell; Jones, Richard L.; North, D. T.; Holt, G. G. (Dept. of Agriculture, Tifton, Ga.). J. Econ. Entomol.; 65: No. 3, 906-8(Jun 1972).

The effects of irradiation on sperm transfer by adult males, and the attractiveness of females (previously mated with irradiated males) to native males were studied as part of a cooperative effort to control the corn earworm (Heliothis zea). Adult males used in the study were exposed to either nonsterilizing: 0 krad, partially-sterilizing: 17.5 krad, or sterilizing: 35 krad doses of ^{60}Co γ radiation. The results indicated that females containing irradiated male sperm were as attractive as virgin females, and that females mating with untreated males were significantly less attractive. The results also indicated that irradiated males transferred significantly less normal sperm than untreated males, the decrease being greater for sterile males than for partially sterile males. (E.R.B.)

43357 FERTILITY OF MOTHS OF PINK BOLLWORM REARED FROM IRRADIATED EGGS. Wolfenbarger, Dan A.; Mangum, Charles L. (Dept. of Agriculture, Brownsville, Tex.). J. Econ. Entomol.; 65: No. 3, 919-21(Jun 1972).

Eggs of the pink bollworm (Pectinophora gossypiella) were γ-irradiated at doses of 1, 2, 4, and 8 krads at 1, 2, 3, and 4 days following oviposition and reared to adults to determine the effects of irradiation of the egg on the fertility of adult moths. Moths emerging from irradiated eggs were crossed with moths of the opposite sex emerging from unirradiated eggs and data on mating, fertility, and fecundity were recorded. The results indicated that moths of both sexes emerging from irradiated eggs were sexually sterile, but both the age and sex of the eggs influenced the results. (E.R.B.)

43358 INVESTIGATIONS ON RADIOSENSITIVE AND RADIORESISTANT POPULATIONS OF DROSOPHILA MELANOGASTER. II. RESTRICTION OF THE DECREASE IN RADIOSENSITIVITY OF THE IRRADIATED POPULATION ROE I TO STAGE-7 OOCYTES. Noethel, H. (Freie Univ., Berlin). Mutat. Res.; 15: No. 3, 277-86(Jul 1972).

An irradiated (RÖ I) and a contemporaneous control (+60) population (both of which originally were derived from the Berlin wild stock of Drosophila melanogaster) were tested for possible differences in radiosensitivity. Prior to the commencement of the present studies, the irradiated population had been exposed to 2100 R of x rays each generation for over 220 generations in an experimental design which involved the sampling of oocyte stages 6–14, mature spermatozoa and spermatids in each generation. The data show that in none of the germ-cell stages tested (stage-14 oocytes, nurse cells of stages 4–6 oocytes, spermatozoa and spermatids) was there any evidence for a lower radiosensitivity of RÖ I with any of the measured end-points of radiation damage. These results stand in contrast to those from the earlier tests on stage-7 oocytes sampled from the same populations, in which a markedly decreased radiosensitivity of the RÖ I population had been observed. They thus indicate a restriction of the decrease in radiosensitivity to one or a few germ-cell stage(s). The present results provide additional evidence for the hypothesis (advanced in the earlier study) that the decrease in radiosensitivity of stage-7 oocytes in the RÖ I population is not due to a shift in the germ-cell stages sampled. (auth)

43359 RADIOSENSITIVITY OF DROSOPHILA SPERM BEFORE AND AFTER INSEMINATION OF THE EGG. Graf, Ulrich (Eidgenoessische Technische Hochschule, Zurich). Mutat. Res.; 15: No. 3, 287-301(Jul 1972). (In German).

The radiosensitivity of mature sperm before and after insemination of the egg was determined with respect to the induction of sex-linked recessive lethals and reciprocal translocations. In two separate series, inseminated females and newly laid eggs, respectively, were x-rayed either in air, oxygen or purified nitrogen. The use of a special test system allowed the recessive lethals (including orthodox as well as Y-suppressed lethals) to be registered separately in the maternal and in the paternal X-chromosomes. Using this procedure in both series we also obtained information about the sensitivity of the maternal chromosomes. A comparison of the dose-response relationships for the recessive lethals leads to the following results: The maternal X-chromosome of stage-14 oocytes has about the same sensitivity as that of newly laid eggs. The paternal X-chromosome of mature sperm in the storage organs of the females is less sensitive than the maternal X-chromosome of stage-14 oocytes. In contrast to this, the paternal X-chromosome of sperm which have just penetrated into the egg is more sensitive than the maternal X-chromosome of newly laid eggs. The sensitivity of the sperm after insemination is twice as high as before insemination. These differences are independent of the gas that is present during irradiation. The oxygen enhancement ratios obtained from irradiations of inseminated females are somewhat higher than those obtained from irradiations of newly laid eggs. From these results it is concluded that the doubling of the sensitivity of the sperm after insemination is not caused by an oxygen effect, i.e. by a differential oxygen content of the sperm in the two different environments. We assume that the increase in sensitivity is connected with the histone transformation in the paternal chromosomes during the transition into the pronucleus which is accompanied by a decrease of free SH-groups acting as radiation protectors. The possibility of a differential influence of maternal factors on the x-ray-induced lesions in the paternal chromosomes cannot be excluded. (auth)

43360 DOSE-RESPONSE KINETICS OF GENETIC EFFECTS INDUCED BY 250-kVp X-RAYS AND 0.68-MeV NEUTRONS IN MATURE SPERM OF DROSOPHILA MELANOGASTER. Gonzalez, Frank W. (Columbia Univ., New York). Mutat. Res.; 15: No. 3, 303-24(Jul 1972).

Mature sperm from Drosophila melanogaster males that had been irradiated with several doses of 0.68-MeV neutrons or 250-kVp x-rays were tested for the presence of translocations, sex-linked recessive lethal mutations and dominant lethal mutations. The data support the conclusions that: neutrons induce all these effects by the action of single proton tracks; some x-ray-induced translocations and dominant lethals are produced by single electron tracks while the remainder are produced by at least two tracks; x-ray-induced recessive lethal mutations are produced by single electron tracks. The relative biological effectiveness (RBE) for all the effects was >1. (auth)

43361 REPAIR OF DIGESTIVE TUBULE TISSUE OF THE PACIFIC OYSTER, CRASSOSTREA GIGAS, DAMAGED BY IONIZING RADIATION. Mix, Michael C.; Sparks, Albert K. (Univ. of Washington, Seattle). J. Invertebr. Pathol.; 17: No. 2, 172-7(Mar 1971).

Degeneration of the digestive tubules following γ irradiation with 20 Krads is briefly described. Epithelial denudation is the ultimate observable manifestation. All normal epithelial cells, i.e., crypt or generative cells, secretory and absorptive cells, are sloughed and only an abnormal squamous cell lining remains. Cell repopulation or regeneration begins with the formation of cell nests or epithelial islands through mitotic division of either uninjured or repaired crypt cells, or possibly both. Subsequent migration of these cells from the islands ultimately results in reepithelization of the tubule. (auth)

43362 EFFECT OF GAMMA RADIATION ON LARVAL RESISTANCE TO BACILLUS THURINGIENSIS INFECTION. Rossmoore, H. W.; Hoffman, E. A. (Wayne State Univ., Detroit). J. Invertebr. Pathol.; 17: No. 2, 282-3(Mar 1971).

Relationships between radiation dose and susceptibility to Bacillus thuringiensis infection in the tussock moth, Hemerocampa leucostigma, were investigated. Larvae were given intrahemocoel injections of the largest dose of spore-crystals found to produce significant mortality. When the post-radiation time for infection was extended to ten days there was a depression of resistance to bacterial intoxication and infection. Evidence suggested that midgut cells become disorganized as early as one day after irradiation, while depression in total hemocyte count does not appear until seven days. (H.L.W.)

43363 MEIOSIS IN TRANSLOCATION HETEROZYGOTES IN THE MOSQUITO CULEX PIPIENS. Jost, E.; Laven, H. (Univ., Mainz). Chromosoma; 35: 184-205(1971).

Irradiation of male germ lines in C. pipiens produced one principal category of chromosome mutations, namely symmetrical exchanges between nonhomologous chromosomes. Ten translocations have been described. In one case a pericentric inversion and an isochromosome exchange have been observed in lines isolated by the semisterility screening technique. The cytological analysis supported a correlation between linkage groups and chromosomes, showing that the small chromosome 1 is the chromosome with the sex factor and the sex linked genes. All the exchanges were between euchromatic segments of the three chromosome pairs with about equal frequencies according to which chromosomes of the different size groups were involved in exchanges. Meiotic behavior is characterized by large asynaptic regions in the center of the cross at late pachytene and diplotene. The reason is the generally low chiasma frequency in Culex in addition to a reduced chiasma frequency in the interstitial segments. A model is proposed for the calculation of expected frequencies of distribution of meiosis I in translocation heterozygotes. Ring configurations are less frequent than chains and "pairs" in translocations between the small chromosome 1 and an autosome. Translocations between chromosome 2 and 3 form rings in a higher extent if the interstitial segments are short. If the interstitial segments are long rings and chains are uncommon, pairs are usual. Alternate distribution is more frequent than adjacent-1- and adjacent-2-distribution. However, adjacent-2-distribution has been observed in ring and chain configurations. The role of translocations and the probability of their effective use in pest eradication programs are discussed. It is suggested that a double translocated homozygous line, which could be obtained by irradiating single homozygous translocations, is the most promising system for a control program. (auth)

43364 FOOD IRRADIATION IN PAKISTAN. Sattar, Abdus; Ali, Mumtaz; Muhammed, Amir. Food Irradiat.; 11: No. 4, 7-12(Jul-Dec 1971). (In French).

A 4,188 Ci source was used to irradiate (0 to 80 krads) cereal products (wheat and rice) in order to rid them of insects, certain fruits and vegetables in order to delay their ripening (mangos, oranges, bananas, guava, tomatoes, and peaches), and potatoes and onions to inhibit their germination. Irradiated fruit and vegetable samples were then submitted to organoleptic tests concerning their color, texture, flavor, and savor. (France)

43365 RADIOPROTECTIVE EFFECTS OF DIMETHYL SULFOXIDE IN DROSOPHILA MELANOGASTER. Barnett, Beatriz Mazar (Comision Nacional de Energia Atomica, Buenos Aires). Radiat. Res.; 51: No. 1, 134-41(Jul 1972).

The radioprotective effects of dimethyl sulfoxide against damage caused by ionizing radiation have been studied in Drosophila melanogaster. Pretreatments with a 10% solution (v/v) in 0.4% NaCl, injected intraabdominally were done at different intervals prior to irradiation. In all the experiments the response to dimethyl sulfoxide was more marked when the interval between administration and irradiation was shorter. The results obtained showed an increase in the survival of adult males and females treated 2 h or 20 h before irradiation with 64,000 R of γ radiation; a decrease in the frequency of sex-linked recessive lethal mutations induced by 1000 R of x rays in sperm of males injected 30 min or 20 h before irradiation; a decrease in the frequency of II-III translocations induced by 1000 R of x rays in sperm of males injected 30 min before irradiation. It is concluded that dimethyl sulfoxide can provide radioprotection to D. melanogaster both at the whole body and genetic levels. (auth)

43366 MEASUREMENT OF RADIATION-INDUCED DOMINANT LETHALS IN STAGE-14 OOCYTES OF DROSOPHILA. Osgood, C.; Zimmering, S. (Brown Univ., Providence). Mutat. Res.; 15: No. 3, 355-7(Jul 1972).

Female flies were collected, x-irradiated at 500 R, and individually mated with males. The females were then placed in vials and allowed to deposit eggs for 5 hr; they were then transferred to fresh vials and the procedure was repeated after 10 hr and 24 hr. Eggs were counted following each transfer and hatching was scored 24 hr after deposition. Tables are presented to show radio-induced dominant lethals in eggs deposited over a 24 hr period. The average of egg hatch in each of the three broods was 39%, 57%, and 67%, controls being about 95%. (H.L.W.)

43367 CELL INTERACTION DURING REGENERATION OF NORMAL AND RADIATED HYDRAS. Bhattacherya, Satyabrata (Presidency Coll., Calcutta). Indian J. Exp. Biol.; 10: No. 1, 8-12(Jan 1972).

The lethally x irradiated anterior half of Hydra vulgaris was grafted to a normal posterior half of the same species and the regeneration of the hypostome was studied. The lower normal half influenced the regeneration of the tentacles at the anterior terminal end. Even before the arrival of the normal cells from the lower portion, the amputated end developed tentacles. The cells that invaded the irradiated portion were predominantly interstitial cells. Interstitial cells that invaded the endoderm differentiated into gland cells and contributed largely to the differentiation of the new hypostome. The ectodermal interstitial cells differentiated into nematocysts which ultimately reached the developing tentacles. Due to the addition of the normal cells, the grafted animal overcame the effect of radiation and started budding 10 to 12 days after amputation. Only 20% of the radiated hydras were able to form tentacles after 120 hr of regeneration whereas 100% of the grafted animals regenerated tentacles and hypostome within the same period of time. (auth)

43368 SOME EFFECTS OF GAMMA RADIATION ON THE STRIPED STEMBORER OF RICE, CHILO SUPPRESSALIS WALKER. Manoto, E. C.; Fernandez, G. B.; Viado, G. B. (Philippine Atomic Research Center, Diliman). Philipp. Nucl. J.; 2: No. 2, 177-91(1970).

Different metamorphic stages and ages of the striped rice stemborer, Chilo suppressalis Walker, were exposed to various levels of gamma radiation from a ^{60}Co source. Doses used were 3, 5 and 7 KR and an additional 10 KR for the 3 to 4 day old pupae. The dose rate for all treatments was about 533 R/min. The pupae were the most tolerant to radiation, followed by the larvae and then the eggs. The lethal effect is most significant on the egg. Younger age groups among the different metamorphic stages were more susceptible than older ones. Five KR is sufficient to sterilize the larvae and pupae of the rice stemborer. Radiation damage manifested itself not only in mortality and sterility but also in certain abnormalities in the larvae and adults. Egg hatch, development, reproduction and mortality of the insect were greatly affected by radiation. The reproductive capability of the progenies was impaired, which may be the result of genetic damage produced by radiation on the parents. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 43278, 43279, and 43389.

43369 (AECL-4150) ASSESSING AND CONTROLLING THE HAZARD FROM TRITIATED WATER. Bush, W. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Apr 1972. 106p. Dep. NTIS (U. S. Sales Only). AECL $2.00.

Practical and theoretical information is presented to help radiation surveyors and operators of heavy-water reactors and upgrading plants to understand, assess, and control the radiation hazard from tritiated water (HTO or DTO). The intake of HTO through the skin and lungs, its excretion, and the associated radiation dose are discussed, and concepts such as critical organ, dose commitment, maximum permissible concentration in air $(MPC)_a$, and $(MPC)_a$-hour are explained. Methods for controlling the hazards from tritiated water are discussed: HTO detection in air and urine; ventilation and containment for limiting HTO concentrations in working areas; air-supplied respirators for preventing inhalation of HTO vapour; and protective clothing, barrier creams, and washing after exposure to minimize intake of HTO through the skin. Exposure-control criteria and the reduction of dose commitment by increasing water intake are also explained. (auth)

43370 LEUKEMIA INCIDENCE IN ADULTS FOLLOWING ^{131}I IRRADIATION. Tomkins, Edythalena (Environmental Protection Agency, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 64(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43371 ROLE OF THE INDUSTRIAL DOCTOR IN A NUCLEAR PLANT DURING INTERVENTIONS INVOLVING CONTAMINATION OR EXTERNAL IRRADIATION RISKS. Dore, A. (Electricite de France, Saint-Laurent-des-Eaux). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 91, 34-7(Sep 1971). (In French).

The role of industrial medicine in interventions involving contamination or irradiation risks is essentially preventive. A correlation must be established between the state of health of the individual and his work. This correlation is effected before the intervention (except in the case of an emergency) by studying the work that the individual must accomplish and his complete medical dossier. The study must involve the geographical environment, normal and exceptional working conditions, and the general conditions associated with an intervention. During the intervention, the industrial doctor should check the dosimeter readings of exposed persons, the hygiene conditions, and the safety aspects, and should be able to predict whether clinical treatment will be necessary. The doctor must be capable of dealing with situations involving acute irradiation. After the intervention, the doctor must verify that the person has not accidentally become internally contaminated. (France)

43372 RADON EMANATING FRACTION IN DIAL PAINTERS. Lenger, V.; Houskova, M.; Malatova, I. (Inst. of Hygiene and Epidemiology, Prague). Health Phys.; 23: No. 1, 109-11(Jul 1972).

It is stated that the exact determination of ^{226}Ra whole-body activity in man is based on measurements of Ra (B + C) γ-activity deposited in the body, corrected by the radon fraction escaping into the expired air, and it is important to know this fraction when calculating the dose due to the ^{226}Ra deposit, since a considerable part of the absorbed energy originates from radon and its daughter products. Available data on the values of the retained fraction are reviewed and found to differ rather widely. The present authors conclude that large percentage fluctuations in radon exhalation may occur without correspondingly large fluctuations of the retained fraction. Results are given of measurements made on a group of 16 dial painters and two interlaboratory comparisons in which the whole-body deposit exceeded 0.01 μCi ^{226}Ra. The exhaled fractions were calculated from measurements of the exhaled radon and from whole-body RaC measurements. The mean value of the radon emanating fraction was found to be 0.681 ± 0.045. (UK)

43373 EFFECT OF ^{32}P-THERAPY ON THE VOLUME DISTRIBUTION OF THE ERYTHROCYTE AND LEUKOCYTE POPULATION. Chone, B.; Spiel, M. (Univ., Heidelberg). Radiobiol.-Radiother.; 12: No. 6, 737-49(1971). (In German).

The volume distribution curve of erythrocytes and leukocytes in the peripheral blood were examined in 36 polycythaemia patients following ^{32}P therapy. The examinations were done by means of an electronic blood-counter that permits a separate determination of the absolute counts and volume distribution curve. As a functional parameter of the examination reticulocyte counts were considered. The differentiated evaluation of the result of the examination revealed the following relations: In the remission phase of the disease erythrocyte maxima and reticulocyte counts fluctuated similarly by a mean value which differed individually. In the active phase of the disease after ^{32}P-application an increase of the mean erythrocyte count appeared with simultaneous reduction of the reticulocyte count. The change of leukocyte volumes did not prove suitable for the long-lasting evaluation of the course of the disease. In the early detection of the radiation injury reduction of the maximum of leukocyte volume was more significant considering the shorter survival time of this cell-class. (auth)

Animals

Refer also to abstract 43322.

43374 (ORO-3792-9) DEVELOPMENTAL APPROACH TO THE STUDY OF IMMUNOLOGIC TOLERANCE. Progress Report, April 1, 1971—June 1, 1972. Hyde, Richard M. (Oklahoma Univ., Oklahoma City (USA). Dept. of Microbiology and Immunology). 1972. Contract AT(40-1)-3792. 20p. Dep. NTIS.

Progress is reported in studies on the induction of immune tolerance to human gamma globulin in mice. A direct investigation of the sensitivity of thymus and bone marrow cells to human gamma globulin (HGG) induced immune tolerance was made. Lethally x irradiated recipient mice were injected intravenously with approximately 4.5×10^7 syngeneic thymus (T) cells and 1.5×10^7 syngeneic bone marrow (BM) cells from HGG-treated donors and assayed for splenic plaque-forming cells five days after a second injection of HGG. The per cent responsiveness of the recipients of tolerant T or BM cells was calculated by dividing their PFC response by that obtained in irradiated recipients of T and BM cells from normal syngeneic donors. Sensitivity to sHGG-induced immune tolerance apparently resides in the T cell population, as in only one instance were BM cells significantly depressed, whereas T cell depression followed the pattern seen when tolerance is induced in intact adults of the three strains. BALB/c T cells were more resistant to tolerance induction than were T cells from either C57BL/G or CBF$_1$ animals. (C.H.)

43375 PROLONGED LYMPHOCYTOPENIA IN THE RAT. THE DEPLETION OF BLOOD AND THORACIC DUCT LYMPHOCYTE POPULATIONS FOLLOWING INJECTION OF β-EMITTING COLLOIDS INTO THE SPLEEN OR LYMPH NODES. Roser, Bruce; Ford, W. L. (Oxford Univ.). Aust. J. Exp. Biol. Med. Sci.; 50: Pt. 2, 165-84(Apr 1972).

In order to produce a selective deficiency of recirculating small lymphocytes by exploiting their radiosensitivity and unique migration pattern, an attempt was made to confine a permanent field of radiation to lymphoid organs. A technique was developed for the direct injection into rat spleens of the β-emitting isotope ^{32}P in the form of colloidal chromic phosphate. Most of the isotope was retained in the spleen for several weeks. Some reached the liver and the parathymic lymph nodes but the concentration in these and other organs was very low. This procedure was followed by a deficit of lymphocytes both in the blood and in thoracic duct lymph. The rate at which these rats became lymphocytopenic and the tempo of their recovery were investigated. Another series of rats was given intrasplenic injections of ^{185}W in the form of tungsten trioxide. This isotope is a pure β-emitter with a half-life five times longer than ^{32}P. It also produced lymphocytopenia that was much more prolonged than after ^{32}P. A substantial deficit of thoracic duct lymphocyte output was sustained for at least 12 weeks. After lymphocytopenia was induced by intrasplenic injection of ^{185}W, splenectomy was performed. Removal of the radioactive focus was followed by a rapid recovery in the blood lymphocyte level. It is argued that the maintenance of lymphocytopenia in isotope-injected rats was due to the killing of small lymphocytes by radiation during their physiological migration through the radioactive areas of the spleen. As an alternative to intrasplenic injection, the cervical lymph nodes were injected with ^{185}W. This was less effective in lowering blood lymphocyte levels but was equally as effective as intrasplenic ^{185}W in lowering thoracic duct output. When an intrasplenic injection of ^{185}W was followed by an intranodal injection of ^{185}W an additional lowering of the blood lymphocyte level was found. Thymectomy performed before combined intrasplenic and intranodal ^{185}W injections had no additional effect on the already low blood lymphocyte levels. Most rats injected with either ^{32}P or ^{185}W gained weight and showed no abnormality in other blood cells. However, a few rats, that were given intrasplenic ^{32}P, developed hemolytic anemia and one rat, after two injections of ^{185}W, contracted a transferable lymphocytic leukemia. (auth)

43376 PROLONGED LYMPHOCYTOPENIA IN THE RAT. THE IMMUNOLOGICAL CONSEQUENCES OF LYMPHOCYTE DEPLETION FOLLOWING INJECTION OF ^{185}W–TUNGSTEN TRIOXIDE INTO THE SPLEEN OR LYMPH NODES. Roser, Bruce; Ford, W. L. (Oxford Univ.). Aust. J. Exp. Biol. Med. Sci.; 50: Pt. 2, 185-98(Apr 1972).

The intrasplenic injection of colloidal ^{185}W-tungsten trioxide is followed by a deficit of small lymphocytes in blood and thoracic duct lymph that persists for many weeks. Recirculating small lymphocytes are the only cells affected and the rats remain in good general condition. The immunological performance of such rats was compared to that of splenectomised controls. The serum hemolysin response to sheep erythrocytes was depressed by 3 $\log_2$ units. The primary agglutinin response to S. adelaide flagella was more depressed (by 5 $\log_2$ units) but the secondary response to flagella, in rats primed before lymphocytopenia was induced, was barely affected. The effect of lymphocytopenia on skin allograft survival depended on whether a weak or strong antigenic difference was involved. Skin allograft survival in a weak strain combination (Ag-B identical) was prolonged from 10 days to a mean of 22 days. By contrast, skin allograft survival in strong strain combinations (Ag-B different) was only very marginally affected and thymectomy prior to the induction of lymphocytopenia had no additional effect. Although no explanation is provided for the discriminatory effect of lymphocytopenia on reactions to weak and strong histocompatibility antigens, it is probably associated with the much higher proportion of lymphocytes reactive to strong antigens. (auth)

43377 LONG-TERM EFFECTS OF INTERNALLY DEPOSITED RADIONUCLIDES. Goldman, Marvin (Univ. of California, Davis). Trans. Amer. Nucl. Soc.; 15: No. 1, 449-50(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43378 DYNAMICS OF THE ^{239}Pu-INDUCED OSTEOSARCOMA GROWTH RATE. Pesternikov, V. M.; Bukhtoyarova, Z. M. Med. Radiol.; 17: No. 3, 19-24(Mar 1972). (In Russian).

Roentgenological findings formed a groundwork for a quantitative assessment of osteosarcoma growth rate in rats following a single intraperitoneal administration of 2.5 mCi/kg of ^{239}Pu citrate. Osteosarcomas are shown to originate predominantly not at the sites of the highest isotope concentration. Of some tumors, primary multiple growth was characteristic. Possible extrapolation for determining the osteosarcomas development time is discussed. (auth)

43379 SHORT-TERM FEEDING EXPERIMENTS WITH IRRADIATED RICE. Faizur Rahman, A. T. M. (Atomic Energy Centre, Dacca, Pakistan); Hossain, Abul; Amin, Ruhul; (and others). Nucleus (Karachi); 8: No. 4, 121-8(1971).

Laboratory rats, fed non-irradiated and irradiated rice, were observed for growth and morphological appearance, subjected to different tests of blood, e.g., the total counts of RBC, WBC and differential counts of WBC, determination of hemoglobin content, blood clotting time, assay of the alkaline phosphatase and aspartate-glutamate transaminase activity, and estimation of fat, protein, and total nitrogen from rat liver to assess toxicity. It was felt that further experimentation with unboiled rice was necessary. (auth)

43380 PATHOLOGY OF RADIOSTRONTIUM EXPOSURE IN CATS. Ward, Jerrold M.; Wright, James F. (Twinbrook Research Lab., Rockville, Md.). Radiat. Res.; 51: No. 1, 84-96 (Jul 1972).

Thirty-three cats of two age groups were fed one of three dosage levels of ^{89}Sr for 30 days. Twenty-four died or were killed before 107 days after the experiment was started. Mortality and bone marrow lesions were dose related. All cats had varying degrees of a hemorrhagic disease with hemorrhages most commonly observed in the heart, subcutis and intestines. Histologically, bone marrows of cats dying before 35 days postexposure were depleted of cells. Those dying later had cellular marrows composed predominantly of erythropoietic precursors. Myelofibrosis was seen in 5 cats and myeloid metaplasia, primarily in lymph nodes, developed in 6 cats. Dysplastic lesions occurred in the epiphyseal plate and metaphysis of long bones. Other lesions included atrophy of the thymus and lymphoid tissues and bacterial lesions in several tissues. Ultrastructural studies of bone marrow of 4 cats revealed degenerative changes in mitochondria of plasma cells and the presence of abnormal erythrocyte precursors. Comparative aspects of the pathology of radiostrontium exposure are discussed. (auth)

43381 ACTIVITY OF NUCLEASES IN RABBIT LUNGS AFTER INHALATION OF PLUTONIUM. Mushkacheva, G. S. (Inst. of Biophysics, Moscow). Vop. Med. Khim.; 17: No. 3, 301-5 (1972). (In Russian).

Activities of acid DNase and both acid and alkaline RNases after a single plutonium inhalation (1.5 μC) into rabbit lung were studied within 4 months. An increase (up to 139%) in the acid DNase activity per 1 g of the fresh tissue during first two weeks after inhalation was noted. An increase in the total activity of acid DNase took place within the period of investigation, the maximal increase (185% of the control) being within the first month after inhalation. The total activity of acid RNase was increased (106 to 173%) within the period of investigation. The activity of alkaline RNase was increased (183%) only within a month after inhalation. The problem of the importance of nucleases activation under irradiation induced damages and during postirradiation recovery is discussed. (auth)

43382 EFFECT OF ORALLY ADMINISTERED TRITIATED THYMIDINE ON REPRODUCTIVE CAPACITY OF FIELD RATS. de la Cruz, Benjamin; Madriaga, Calixto (Philippine Atomic Research Center, Diliman). Philipp. Nucl. J.; 2: No. 2, 229-31(1970).

Six pairs of rats were given water containing tritiated thymidine and a seventh pair served as a control. It was found that abnormalities were present in the offspring of the exposed animals and their reproductive capacity was impaired. Results are presented in the form of tables. (H.L.W.)

Nuclide Kinetics and Toxicology

43383 (EUR-4830) PROGRAMME BIOLOGY, HEALTH PROTECTION. Annual Report, 1971. [Volume] I. (European Communities, Luxembourg. Commission). 479p. (In several languages). Dep. NTIS (U. S. Sales Only). EUR B.Fr. 1,000.-.

Brief summaries are presented of research studies sponsored by EURATOM during 1971 in the fields of radiation protection and applications of nuclear technology in agriculture. Radiation protection studies included: the development and performance testing of personal radiation dosimeters; the transport of radioisotopes through the environment; animal studies on the toxicity of internally deposited radioisotopes; and the development of methods for treatment of the radiation syndrome in mammals. Agricultural studies included: the development of radioisotope tracer techniques for studies on the transport of ions and nutrients in soil and their absorption and translocation in plants; the use of radiations to induce mutations in plants for improved agricultural characteristics; the use of radiations for the control of insects of interest to agriculture; and the development of methods for the detection of radiation processed foods. (C.H.)

Man

Refer also to abstract 42996.

43384 (NP-19367) ASSAY OF ^{90}Sr IN HUMAN BONE IN THE UNITED KINGDOM. Results for 1969. Monitoring Report No. 18. (Medical Research Council, London (England)). Feb 1971. 19p. Dep. NTIS (U. S. Sales Only). UK 18½ pence.

Data are presented on the content of ^{90}Sr in samples of human bone collected in the United Kingdom during 1969. The data are divided into age groups. (C.H.)

43385 STORAGE AND EXCRETION OF ^{224}Ra (-THORIUM X) DURING TREATMENT OF ANKYLOSING SPONDYLITIS. Klemm, C.; Michel, K.; Rose, E.; Meringdal, J. (Rheumaklinik Landesbad, Aachen. Kernforschungsanlage, Juelich, Ger.). Z. Rheumaforsch.; 29: No. 7-8, 234-40(Jul-Aug 1970). (In German).

Results are reported on two total-body counts and excretion measurements during radium-224 treatment of two patients treated for advanced ankylosing spondylitis. Information that the main part of the activity is excreted with the feces and only an unimportant portion in the urine was confirmed. Total-body measurements made gave similar results. The results of the total-body measurements are presented and discussed. It appeared that 7 days following the 9th injection only 5% of the incorporated radium-224 was detectable in the body spectrum. The spectra measured on the 9th and 10th day before and after the injection were nearly the same. (auth)

43386 REPORT OF COMMITTEE 4 ON EVALUATION OF RADIATION DOSES TO BODY TISSUES FROM INTERNAL CONTAMINATION DUE TO OCCUPATIONAL EXPOSURE. CIPR–10. Fontenay-aux-Roses, France; Centre d'Etudes Nucleaires ([1971]). 145p. (In French).

Translation of Report of Committee 4 on Evaluation of Radiation Doses to Body Tissues from Internal Contamination Due to Occupational Exposure, Oxford, Pergamon Press, 1968.

Information on the metabolism of radionuclides in the body (intake and excretion) is presented. The monitoring methods and programs used are described: study of the working environment, control of the worker by analyzing his excreta, or measuring directly the body radioactivity. The amount of radionuclide in the body and the radiation dose received by a critical organ can be deduced from this information. (France)

43387 FURTHER OBSERVATIONS ON THE NORMAL RADIOACTIVE IODINE UPTAKE. Harvey, William C.; Kopp, David T.; Bovie, Warren W. (Air Force Medical Center, Lackland AFB, Tex.). J. Nucl. Med.; 13: No. 7, 548-50(Jul 1972).

The ^{131}I uptake of 432 euthyroid, 60 hyperthyroid, and 32 hypothyroid patients was studied. Results showed a statistically abnormal population. By purely arbitrary setting of limits, normal values for radioactive iodine uptake were established. The new normal range for RAIU is 5 to 31%. (auth)

43388 EFFECT OF ORALLY AND INTRAVENOUSLY ADMINISTERED STABLE STRONTIUM ON ^{90}Sr METABOLISM IN MAN. Spencer, Herta (Veterans Administration Hospital, Hines, Ill.); Samachson, Joseph; Hardy, Edward P. Jr.; Rivera, Joseph. Contract AT(11-1)-1231-62. Radiat. Res.; 51: No. 1, 190-203(Jul 1972).

The effect of orally and of intravenously administered stable strontium on ^{90}Sr metabolism was investigated in man under strictly controlled dietary conditions. The oral dose of stable strontium averaging 1517 mg/day was given as the lactate for 24 to 48 days. Intravenous infusions of stable strontium as the gluconate were given in 500 ml 5% glucose in water over 4 hours on 6 consecutive days. The amounts of stable strontium infused per day were 318, 612, 954, and 1200 mg, respectively. ^{90}Sr and calcium balances were determined before and during the oral and intravenous administration of stable strontium. Stable strontium given orally or intravenously increased the urinary ^{90}Sr excretion. This increase was greater when stable strontium was given intravenously than orally, the average factor of increase being 3 and 1.65 in the two studies, respectively. The fecal ^{90}Sr excretions did not increase during either oral or intravenous administration of stable strontium. The ^{90}Sr balances changed little during the oral intake of stable strontium while they became more negative during the infusions of stable strontium. The urinary calcium increased during the oral or intravenous administration of stable strontium and this increase was greater when stable strontium was given intravenously than orally. (auth)

43389 METABOLISM AND BIOLOGICAL EFFECTS OF ^{210}Po. Moroz, B. B.; Parfenov, Yu. D. (Inst. of Biophysics, Moscow). At. Energy Rev.; 10: No. 2, 175-232(1972).

Existing data on the metabolism and biological effects of ^{210}Po are summarized. The routes by which ^{210}Po is taken into the body (through the gastro-intestinal tract, the respiratory system, and the skin) and the absorption coefficients applicable to these intake routes are considered. The mechanism of ^{210}Po deposition in organs and tissues, its distribution through the body, and the relation between distribution and the type of experimental animal and the intake route are discussed. Information on the dynamics of ^{210}Po metabolism, excretion in urine and feces, and secretion in milk is presented. Consideration is given to toxic doses of ^{210}Po, curtailment of lifetime as a function of the dose administered, relative biological efficiencies, and minimum effective doses. The clinical picture of acute, subacute, and chronic radiation sickness caused by ^{210}Po is described, providing data on the structural changes in various organs and systems. Considerable attention is devoted to the functional shifts that occur in the cardiovascular, neuro-endocrine, and circulatory systems. Data on organ pathology, in particular on the condition of the liver, kidneys, and other organs, are given and the information available on changes in exchange processes and immunity is reviewed. A number of questions relating to the pathogenesis of radiation injury are discussed. Some of the characteristic features of the action of ^{210}Po on the body are defined. Data are given on the remote tumoral and non-tumoral effects of ^{210}Po. In conclusion, information on standards for maximum permissible doses of ^{210}Po is presented. (auth)

Animals

Refer also to abstract 43336.

43390 (FRNC-R–4, pp 209-16) METABOLISM AND INTERNAL DECONTAMINATION OF RADIOACTIVE Zr–Nb SALT IN RATS. Gavend, M.; Rinaldi, J. P.; Rinaldi, R. (Univ., Grenoble, France). (In French).

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

Fallout from nuclear explosions contains ^{95}Zr; the daughter product ^{95}Nb is always present. The distribution of these elements in rats and methods of decontamination, after the inhalation of radioactive dusts, are studied. These elements do not present serious hazards with regard to contamination by way of the alimentary chain. Experiments demonstrate that Zr citrate, when administered shortly after contamination, produces a significant increase in the amounts of ^{95}Zr and ^{95}Nb excreted. Thus it seems likely that Zr citrate, administered very soon after contamination, reduces the ability of organs to fix ^{95}Zr and ^{95}Nb, or that the urinary excretion is made easier. (France)

43391 (ORO-2401-59) EXPERIMENTAL MODEL FOR THE EVALUATION OF DIFFERENT TUMOR-LOCALIZING RADIOPHARMACEUTICALS. Kosik, Catherine Verlenden (Vanderbilt Univ., Nashville, Tenn.). Aug 1971. 93p. Dep. NTIS. Thesis.

The tissue distribution of ^{206}Bi-nitrate, ^{67}Ga-citrate, and ^{111}In-chloride was followed in dogs with neoplastic diseases (lymphoma, lymphosarcoma, and benign uterine tumor) during 48 to 72 hours following intravenous injection. The uptake of each radioisotope by neoplastic tissue was compared with the content of blood and skeleton. A twenty-to-one tissue to blood ratio was considered adequate for visualization with scintigraphic imaging equipment. The results showed that ^{67}Ga-citrate uptake by neoplastic tissue was greater than that of either ^{206}Bi-nitrate or ^{111}In-chloride, but that ^{67}Ga-citrate uptake was not highly specific for neoplastic tissues. Possible applications of the radioisotopes as scanning agents for the localization of neoplasms in man are discussed. (C.H.)

43392 (ORO–4106-7) EFFECT OF CALCITONIN ON ^{32}P DISAPPEARANCE FROM PLASMA IN PARATHYROIDECTOMIZED AND NEPHRECTOMIZED RATS. Talmage, Roy V.; Anderson, J. J. B. (North Carolina Univ., Chapel Hill. School of Medicine). 1972. 7p. Dep. NTIS.

The effect of salmon calcitonin on the rate of disappearance of simultaneously administered ^{32}P was studied in rats. It was demonstrated that at one hour post-injection the ^{32}P plasma values were significantly lower in calcitonin injected rats than in their controls. This difference was seen in normal, thyroidectomized, nephrectomized, and parathyroidectomized rats indicating that this was a direct effect of calcitonin independent of renal or parathyroid function. The data in this study confirm the earlier report that calcitonin causes a rapid movement of phosphate out of plasma. (auth)

43393 (RLO–2229-T-3-1) STUDIES ON THE NUTRITION AND METABOLISM OF REINDEER-CARIBOU IN ALASKA WITH SPECIAL INTEREST IN NUTRITIONAL AND ENVIRONMENTAL ADAPTATION. 1971/72 Technical Progress Report, June 15, 1971–August 14, 1972. Luick, J. R. (Alaska Univ., College. Inst. of Arctic Biology). 1972. Contract AT(45-1)-2229. 84p. Dep. NTIS.

The overall objectives of these studies are aimed at the nutritional physiology of reindeer and caribou with special interest in their reactions and adaptations to diet and climatic stresses. To date, most studies have been directed at seasonal changes in carbohydrate metabolism and in the turnover of body fluid pools. Parallel studies are also made in the broad field of radioecology with most research interest centering on the biokinetics of ^{137}Cs, an important fallout radionuclide. Considerable progress continues to be made in developing and testing models that describe kinetics of radiocesium in reindeer and as in the previous year, other activities in the field of radioecology included detailed studies on the transfer of radiocesium from the reindeer cow to calf. Models were constructed and studied by analog computer simulation. One presumably important result of these studies was the development of a new technique for measuring milk consumption of the reindeer calf quantitatively while its mother is grazing under quasi-natural conditions. Similar studies were conducted with deuterium and tritium-labeled water and these results are now being compared with results using the radiocesium technique. Once we have demonstrated that these radioisotopes can be used interchangeably for this work, we will be able to develop multiple radioisotope experiments for the simultaneous evaluation of many parameters of body fluid kinetics and intermediary metabolism. A major experiment was conducted this year in the field of radioecology. It involved the feeding of lichens to penned reindeer with special interest in determining absorption factors of radiocesium contaminated lichen. Further studies in the field of radioecology include radiocesium turnover in arctic wolves, continued sampling and monitoring of fallout radioisotopes, and seasonal changes in the radiocesium turnover of reindeer. A detailed study was conducted of the effects of diet and temperature on water kinetics of reindeer, the studies being conducted in the controlled environmental chambers at the Institute of Arctic Biology. Further studies in body fluid metabolism were undertaken to determine water flux and compartmentalization of water in the alimentary tract. Progress in developing and perfecting methods for studying digestive physiology; especially comparison of in vitro and in vivo techniques for measuring digestibility and the determination of fermentation rates and the production rates of volatile fatty acids in the rumen and cecum of reindeer is reported. Eighteen experiments were conducted on the contribution of glucose to energy metabolism in lactating reindeer and of glucose C to the biosynthesis of carbohydrate, protein, and fat. (E.R.B.)

43394 (SRO-310-7-2) STUDY OF ENERGY FLOW AND MINERAL CYCLING IN NATURAL POPULATIONS OF THE OLD-FIELD MOUSE, PEROMYSCUS POLIONOTUS. Progress Report, June 1, 1971–May 31, 1972. Smith, M. H.; Golley, F. B.; Gentry, J. B. (Georgia Univ., Athens. Dept. of Zoology). Contract AT(38-1)-310. 11p. Dep. NTIS.

Progress is reported on research on natural populations of the old-field mouse, Peromyscus polionotus, and the cotton rat, Sigmodon hispidus. The research includes data on density estimates, population turnover rates, determination of stable elements and radioisotopes in animal tissues, food, feces, and urine, and caloric determinations. Models are being developed for estimation of flow of biomass through the populations. The relationship of ^{137}Cs and potassium concentrations in the diet is being investigated. (H.L.W.)

43395 TOXICITY OF ^{137}CsCl IN THE BEAGLE. EARLY BIOLOGICAL EFFECTS. Redman, H. C.; McClellan, R. O.; Jones, R. K.; (and others) (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Radiat. Res.; 50: No. 3, 629-48(Jun 1972).

The toxicity of ^{137}CsCl, because of a relatively uniform whole-body exposure, has been investigated as part of a program to evaluate the biological effects of internally deposited radionuclides. Sixty-six beagles (12–14 months of age) were given ^{137}CsCl in saline iv to provide one group of six dogs with mean initial body burdens of 3800 μCi ^{137}Cs/kg and five groups of 12 dogs each with mean initial body burdens of 2800, 1900, 1400, 970, and 0 μCi ^{137}CsCl. Eleven dogs have died at less than 1 year postinjection: the six at the highest level between 19 and 33 days with cumulative whole-body doses of 950 to 1400 rads; four in the 2800 μCi/kg group between 24 and 81 days with cumulative whole-body doses of 860–1400 rads; and one at 77 days in the 1900 μCi/kg group with a cumulative whole-body dose of 1300 rads. Prior to death, all dogs became febrile, anorexic, hemorrhagic, lethargic, dehydrated, and, in some cases, developed diarrhea. The remaining 55 dogs in the study were alive at 1 year or more postinjection. A dose-related depression in the lymphocytes, granulocytes, and platelet values was observed in all groups; a similar depression in packed cell volume was noted only at the three highest levels. There was a dose-related decrease in the serum lactic acid dehydrogenase values in all dogs that died. The clinical and pathological alterations observed during the first year postinjection are described in relationship to the radiation dose. (auth)

43396 KAL'TSII, STRONTSII-90 I STRONTSII V MORSKIKH ORGANIZMAKH. (Calcium, ^{90}Sr, and Strontium in Marine Organisms). Sokolova, I. A. Kiev; Izdatel'stvo Naukova Dumka (1971). 240p.

Two extensive tables of numerical data on the quantities of Ca, ^{90}Sr, and Sr in marine organisms comprise the bulk of this volume. Data are included on the concentrations of the three element/isotopes in various species of animals, the ocean of origin, dry weight/live weight ratios, and biological half life of the isotope. Calculated accumulation coefficients, and the ratio of Sr activity units in the organism to those in the water, i.e., the discrimination coefficient of ^{90}Sr relative to Ca are included. Introductory pages furnish the English and Latin equivalents of Russian names of animals. The experimental procedure used in assaying the isotope/elements in water or ashed tissue is described. (K.S.W.)

43397 KINETICS OF THE TRITIATED WATER METABOLISM IN THE ORGANISM AT DIFFERENT PERIODS OF TRAUMATIC BRAIN EDEMA (EXPERIMENTAL INVESTIGATION). Sakinidze, V. D.; Romanovskaya, L. L. (Inst. of Medical Radiology, Moscow). Med. Radiol.; 17: No. 3, 31-6(Mar 1972). (In Russian).

Kinetics of tissue distribution of tritiated water was investigated upon its intravenous administration to control rabbits and also to rabbits with a history of an acute brain injury, at various post-traumatic periods. With tritium oxide introduced 10 min after sustained injury the character of the curve was found to undergo changes by comparison with controls. It showed a rise, fall-off and a second rise of activity in the blood. After a lapse of 3 and 24 hr from the time of the brain injury, the curves demonstrated two quantitation levels. After 72 and 96 hr, a characteristic type of curve was obtained with a high level of specific activity and an equal relationship manifesting itself by the presence of two maxima. (auth)

43398 BINDING OF THORIUM(IV), PLUTONIUM(IV), AMERICIUM(III), AND CURIUM(III) TO THE CONSTITUENTS OF BOVINE CORTICAL BONE IN VITRO. Chipperfield, Alan R.; Taylor, David M. (Inst. of Cancer Research, Sutton, Eng.). Radiat. Res.; 51: No. 1, 15-30(Jul 1972).

By means of a gel filtration technique it has been shown that thorium(IV), plutonium(IV), americium(III) and curium(III) bind to five glycoprotein fractions isolated from bovine cortical bone and to certain other substances. The effects of pH on the binding of plutonium to poly-L-glutamic acid and to bone chondroitin sulfate and of curium to bone sialoprotein and chondroitin sulfate–protein complex are described. Plutonium, americium, and curium were found to bind to bone glycoproteins in the presence of a 30-fold greater mass of bone mineral than glycoprotein. Some experiments on the precipitation of calcium phosphate in vitro in the presence of plutonium and americium are also presented. These observations are discussed in the light of the hypothesis that certain actinide elements are localized at bone surfaces by binding to glycoproteins. (auth)

Microorganisms

43399 MICROBIOLOGICAL ASPECTS IN THE LEACHING OF URANIUM BY THIOBACILLUS FERROOXIDANS. Tuovinen, O. H. (Queen Elizabeth Coll., London). At. Energy Rev.; 10: No. 2, 251-8(1972).

The microbiological aspects involved in the leaching of uranium by iron oxidizing bacteria are discussed. The following problems are emphasized: toxicity of soluble uranium and organic solvents to Thiobacillus ferrooxidans, and the loss of cells at various stages of the leaching process. Hydrolysis of ferric iron in relation to the acidity and the advantage of the use of pyrite are described. Distinction is made between natural leaching by heterogenous Thiobacillus populations and laboratory studies with pure cultures. (auth)

New Tracer Techniques

Refer also to abstracts 42700, 42702, 42845, and 42967.

43400 (CONF-720430) PROCEEDINGS OF SECOND SYMPOSIUM ON SHARING OF COMPUTER PROGRAMS AND TECHNOLOGY IN NUCLEAR MEDICINE, OAK RIDGE, TENNESSEE, APRIL 21–22, 1972. Gurney, Jane; Maskewitz, Betty F. (comps.) (Oak Ridge National Lab., Tenn.). 1972. 443p. Dep. NTIS.

Thirty-six papers discuss various aspects of the use of computerized data processing systems during clinical radioisotope scanning. Present and future applications of computer technology in nuclear medicine are considered. (C.H.)

43401 (FRNC-R-4) TENTH MEETING ON FUNCTIONAL EXPLORATION USING RADIOACTIVE ISOTOPES, GRENOBLE, SEPTEMBER 20–21, 1968. (Grenoble Univ. (France)). 229p. (In French and English). (CONF-680994).

Separate abstracts were prepared for 10 of the 44 papers presented. The remaining 34 papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 42993–42998, 43390, and 43402–43404.

43402 (FRNC-R-4, pp 47-53) DIVIDED RENAL PLASMA FLOW MEASUREMENT BY EXTERNAL COUNTING. Bianchi, C.; Coli, A.; Palla, R.; Rindi, P.; Giannotti, P. (Univ., Pisa, Italy). (In French).

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

Separated renal flow is usually measured by the catheterization of both ureters during the intravenous perfusion of p-aminohippurate. This method, which is often dangerous and inexact, may be replaced by a new method utilizing ^{131}I-hippuran and external counting of the activity in the kidneys, ureteral catheterization thus being avoided. The urine flow is conveniently stopped, and the radioactivity accumulated in the pelvis of the kidney is assumed to be proportional to plasmatic flow in each kidney. The results obtained resemble those obtained by ureteral catheterization. (France)

43403 (FRNC-R-4, pp 55-9) EVALUATION OF GLOMERULAR AND TUBULAR CLEARANCES FROM RENOGRAMS. Swyngedauw, J.; Swyngedauw, B.; Sulman, Ch. (Centre de Lutte Contre le Cancer Oscar-Lambret, Lille). (In French).

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

A new technique for determining glomerular and tubular clearances from renograms is proposed. ^{131}I-labeled hippuran and ^{125}I-labeled hypaque are used in the measurements. The data obtained from the blood radioactivity curve, the blood concentration, and the urinary concentration after 20 min, using hippuran and hypaque, enable the clearances to be calculated. The procedures used to calculate the clearances for hippuran and hypaque are described. (France)

43404 (FRNC-R-4, pp 217-19) USE OF A Cu COLLOID IN DIAGNOSIS. Henry, R.; Marignan, R.; Bontoux, J.; Gellis, C. (CEN, Saclay, France. Univ., Montpellier, France). (In French).

From tenth meeting on functional exploration using radioactive isotopes; Grenoble, France (20 Sep 1968).

The radioelement, ^{64}Cu, has useful properties with regards to nuclear diagnosis: it is inexpensive; it possesses a half-life of 12.84 hr (it can thus be transported over long distance); it has a 19% β^+ emission rendering it useful when used in conjunction with a positron camera; it has chemical properties facilitating the synthesis of various complexes and colloids, as well as the ability to be easily associated with different protein substances. Tests carried out with animals using a Cu oxide suspension demonstrate that significant fixation occurs in the hepatic region; the hepatic concentration remains high during the first few hours after administration, the colloid is then observed to eliminate itself, until after 24 hr only 8% of the initial level of radioactivity administered is observed in the liver. These properties suggest the usefulness of this colloid in hepatic scintigraphy. (France)

43405 PRESENT SITUATION AND FUTURE ENVISAGED IN THE APPLICATIONS OF RADIOELEMENTS AND RADIATIONS. Emmanuel, H. (CEA, Paris). Energ. Nucl. (Paris); 14: No. 1, 57-8(1972). (In French).

The applications of radioisotopes and radiations in the following fields are reviewed: nuclear medicine (radiodiagnosis, radiotherapy, cardiac stimulators, and artificial hearts), agriculture and food processing, and industry (gages, analysis, tracers, and irradiation). Developments in nuclear techniques are occurring in all countries, including newly developing countries. (France)

43406 SCANNING OF THE SALIVARY GLANDS. Poliquin, J.; Leveille, J. Union Med. Can.; 101: No. 6, 1123-6(Jun 1972). (In French).

Radioisotope scanning of the salivary glands with ^{99m}Tc-sodium pertechnetate is a new diagnostic tool in salivary gland disorders. A few clinical applications are presented. In the near future, this study should permit differentiation between benign and malignant disorders of the salivary glands and should become widely accepted. (auth)

43407 RADIOACTIVE ANALYSIS OF CODLING MOTHS LABELLED WITH ^{191}Ir. Lasceve, G.; Buscarlet, L. A.; Bossy, A. (CEN de Saclay, Gif-sur-Yvette, France). Int. J. Appl. Radiat. Isotop.; 23: No. 6, 265-70(Jun 1972). (In French).

To complete the range of labeling techniques for use in insect ecology, a method is described using stable iridium administered to codling moths (Laspeyresia pomonella) by ingestion, and tracing it by thermal neutron activation. The choice of indicator is governed by its nuclear characteristics, and must take into account the physiological reactions of the insect, (degree of retention and rate of elimination). These two aspects are examined and the sensitivity of the method is indicated. For codling moths labeled at the larval stage, the method is totally discriminative throughout their life as adult insects. (UK)

43408 REDUCTION IN RADIATION DOSE. PULMONARY SCANNING WITH ^{99m}Tc-MICRO-SPHERES. Luetgemeier, J.; Hebestreit, H.-P. (Univ., Heidelberg). Fortschr. Geb. Roentgenstr. Nuklearmed.; 116: No. 4, 534-50(Apr 1972). (In German).

The use of ^{131}I is associated with a high radiation dose. Attempts have therefore been made to replace this commonly used substance by shorter-lived isotopes. For pulmonary scanning, the use of ^{99m}Tc-microspheres results in a tenfold reduction in the dose. In addition, the use of greater injected quantities allows measurements of a higher number of impulses, resulting—at least theoretically—in better picture quality. (auth)

43409 COLLOQUIUM OF INSERM ON EXPERIMENTAL METHODOLOGY IN THYROIDIAN PHYSIOLOGY AND PHYSIOPATHOLOGY, LYON, FRANCE, 21 OCTOBER 1971. Mornex, R.; Nunez, J. (eds.). Boulogne-Billancourt, France; Institut National de la Sante et de la Recherche Medicale (1971). 439p. (In French). (CONF-711053).

Physiological and physiopathological investigations of the thyroid are discussed in this colloquium. Studies concerning cultured thyroid cells, thyroid tissue enzymes, iodoproteins, and circulating hormones are presented. Two papers were processed separately for NSA. (France)

For abstracts of individual papers see: 42691 and 42707.

MATERIALS

Ceramics and Cermets

Refer also to abstracts 42824, 42828, 42829, 42909, 42921, 43195, 43473, 43530, 43539, 43546, 43561, 43581, 44518, 44546, 44588, 44589, 44690, and 44999.

43410 (BARC–596) STUDIES ON ELECTRICAL CONDUCTIVITY OF REFIRED SINTERED URANIUM DIOXIDE PELLETS. Rao, S. V. K.; Agnihotri, P. K.; Anandan, N. S.; Prasad, G. E.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 11p. Dep. NTIS (U. S. Sales Only).

In earlier investigations, it was reported that the electrical conductivity of sintered uranium dioxide pellets depended on the calcination temperature and the sintering treatments and could be related to the microstructure attained. The highest sintering temperature studied was 1700°C. High-density pellets prepared by sintering at 1500°C were refired at 1800, 1900, and 2000°C. Though there were no significant changes in the densities, the electrical conductivity of the samples varied considerably, showing a minima at a refiring temperature of 1900°C. Attempts were made to correlate the changes in electrical conductivity to the microstructural changes which still seem to be influenced by the thermal history of the samples. (auth)

43411 (CEA-R–4284) CONTRIBUTION TO THE STUDY OF THE URANIUM–SILICON–BERYLLIUM PHASE DIAGRAM. Molho, Salomon (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). May 1972. 77p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The isothermal section at 900°C of the U–Si–C equilibrium diagram was mapped, and the existence of three significant solid solutions evidenced: a substitutional solid solution of silicon in the UB$_{13}$ phase extending to 4.1 at.% Si; a solution of beryllium in the USi$_{1.88}$ phase extending to 17 at.% Be; and a solution of beryllium in the U$_3$Si$_5$ phase extending to 26 at.% Be. In the last two phases, the substitution process was found to be preceded by a filling of the silicon vacancies by beryllium atoms. Furthermore, observations performed on melted alloys of various compositions allow an outline of the liquidus to be drawn. The different constituents involved in this system were subjected to an extensive x-ray diffraction study whereby an order-disorder transition taking place in the U$_3$(SiBe)$_5$ phase near its saturation composition could be established. (auth)

43412 (CEA-R–4285) SINTERING OF URANIUM DIOXIDE: INHIBITION OF DENSIFICATION BY DEVELOPMENT OF GAS PRESSURE IN PORES. Francois, Bernard (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr 1972. 93p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

Studies were made on the sintering behavior of high specific surface UO$_2$ powder compacts under hydrogen atmosphere, with special emphasis on the role of the rate of temperature increase from room temperature to 1600°C. It was found that: by a high-speed heating cycle, the main part of the initial porosity may be removed during the heating period, i.e., in less than 10 minutes; if the green density exceeded 50 per cent T. D., the densification was stopped as soon as the sample reached 1600°C; this behavior was correlated with the occurrence of a peculiar microstructure in which the pores were polyhedral in shape and located at the grain boundaries. In these pores, entrapped gases originating from powder impurities, and whose pressure was about 10 atm., inhibited any further increase in density. A similar behavior was also observed in the case of tungsten. Thus such kinds of phenomena may occur quite frequently for the sintering of metals and ceramic compounds. (auth)

43413 (INR-P–1361) STUDIES ON OBTAINING PYROCARBON COATINGS ON SPHERICAL PARTICLES OF URANIUM MATERIALS. Kalinowski, Bohdan; Wlodarski, Rafal; Szterk, Lucjan (Institute of Nuclear Research, Warsaw (Poland)). 1971. 23p. (CONF-700540–11). Dep. NTIS (U. S. Sales Only).

From Polish-Italian seminar on some chemical, ceramic, and metallurgical aspects of nuclear fuels; Zakopane, Poland (29 May 1970).

Work began in 1958 with studies of the pyrolysis of aliphatic and aromatic hydrocarbons in fluid reactors with beds of sand, coke, graphite, sintered aluminum oxide, and other granular materials. The kinetics of the carbon coating growth was studied and a method was devised for applying spherical layers of pyrocarbon on different sized grain beds. A method for coating granular uranium dioxide and uranium dicarbide with pyrocarbon layers was developed with the aim of obtaining granular fuel for HTGRS. The last part of the work (1966 to 69) was performed in cooperation with the Austrian Nuclear Commission and included studies of the quality of granular ceramic fuels (U, Th)C$_2$, (grain size ~300 μ) coated spherically with pyrolytic carbon. After a prolonged activation of the nuclear granules, the degree of penetration of the fission products in the coatings was examined. To this aim, a decoating method has been developed using special mixed solutions that ensured uniform and selective etching. The kinetics of the process were studied. To control the thickness of coating dissolution, the surface quality, microrentgenographic, and metallurgical methods were used. These studies led to determination of the concentration profiles of some fission products in the coatings and their physical state after prolonged activation of the fuel. The majority of the reported studies were not yet published. (auth)

43414 (INR-P–1365) COEXTRUSION OF EK-10 AND WWRSM FUEL ELEMENTS FOR RESEARCH REACTORS. Rutkowski, Wladyslaw; Szteke, Witold; Wieczorkowski, Mariusz (Institute of Nuclear Research, Warsaw (Poland)). 1971. 7p. (CONF-700540–10). Dep. NTIS (U. S. Sales Only).

From Polish-Italian seminar on some chemical, ceramic, and metallurgical aspects of nuclear fuels; Zakopane, Poland (29 May 1970).

In connection with studies on a method for the coextrusion of fuel elements of the EK-10 and WWRSM types, experiments were carried out on the influence of the density of core charge on the density of the extruded element, and on the uniform compactness along its length. The fuel element EK-10 is a dispersion of UO$_2$ in Mg (88 wt% UO$_2$ and 12 wt% Mg). The density of the fuel is 5.55 g/cm^2, which amounts to 83.4% of the theoretical density. The element of the WWRSM-type consists of three concentric tubes. The two central tubes have cylindrical sections and the outer tube has a hexagonal section. Inside the wall (thickness-2.5 mm) of each tube a dispersion fuel UO$_2$–Al is located (enrichment 36% in ^{235}U), its thickness and length being 0.7 mm and 600 mm, respectively. The coextrusion of the elements, containing dispersion cores and cylindrical and hexagonal tubes is presented. Technological aspects involved are also discussed. (auth)

43415 (ORNL-TM–3849) ELIMINATION OF CO$_2$ AND H$_2$O AS OXYGEN TRANSPORT SPECIES IN MIXED OXIDE FUEL PINS. Leitnaker, J. M.; Spear, K. E. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 16p. Dep. NTIS.

Thermodynamic and kinetic calculations show that both CO$_2$ and H$_2$O are eliminated as oxygen transporting species in typical, near-stoichiometric LMFBR mixed oxide fuel. Thus, current gas phase transport theories do not correctly describe the oxygen distribution in such a pin. A method for measurement of the oxygen potential across an oxide fuel pin is presented. (auth)

43416 (SC-DC–714467) TOUGHNESS OF BORSIC–Al COMPOSITES WITH WEAK FIBER-MATRIX BONDS. Hoover, W. R.; Allred, R. E. (Sandia Labs., Albuquerque, N. Mex.). Feb 1972. 28p. (CONF-720515–3). Dep. NTIS.

From fourth annual spring meeting of the Metallurgical Society of AIME; Boston, MA. (8 May 1972).

The toughening mechanism of crack blunting through fiber-matrix debonding in Borsic–Al composites has been examined. It was observed that a plane stress to plane strain transition in the notch tip stress state can be achieved by increasing the composite thickness to above 0.100 in. This stress state transition was found to cause a change in the fiber-matrix bond fracture mechanism, the stress level necessary to cause delamination, and the critical strength ratio for delamination. In addition, it was found that this delamination behavior renders the composite totally notch insensitive; hence, classical brittle fracture appears unimportant in this Borsic–Al composite. The observations of crack blunting through delamination and notch insensitivity are discussed in light of their effects on design. (auth)

43417 (TEE–3056-3) IRRADIATION OF METAL/CERAMIC SHEATH INSULATORS. Poirier, Victor L. (Thermo Electron Corp., Waltham, Mass.). Oct 1971. Contract AT(11-1)-3056. 171p. (TE–4122-42-72). Dep. NTIS.

Sheath insulator specimens were fabricated for testing under conditions appropriate to reactor thermionic fuel elements. Four separate experiments were performed; two in the ETR (thermal neutron spectrum), one out-of-pile control experiment, and one in the EBR-II (fast neutron spectrum). The first experiment, ETR Test No. 1 (ORNL 41-40), consisted of six insulator specimens irradiated at fluences from 1.3×10^{21} to 2.7×10^{21} (n/cm^2, >1 MeV). Specimen temperatures were varied from 550 to 700°C. The irradiation accumulated 4028 hours. The second experiment, ETR Test No. 2 (ORNL 41-42), consisted of 14 insulator specimens irradiated at fluences from 0.5×10^{21} to 4×10^{21} (n/cm^2, >1 MeV). Specimen temperatures were varied from 366 to 815°C. The irradiation accumulated 4273 hours. The third out-of-pile control test experiment consisted of 14 insulator specimens. These specimens were thermally soaked in electric furnaces. Specimen temperatures were varied from 600 to 800°C. The thermal soak accumulated 4294 hours. The duration of this experiment was adjusted to correspond to the thermal soak period of the ETR Experiment No. 2. The purpose of the out-of-pile experiments was to provide guidance for interpreting the separate effects of the nuclear and thermal environments existing in the in-pile irradiations. The fourth experiment, EBR-II (ORNL 0-3), consisted of eight insulator specimens irradiated at fluences from 0.5×10^{21} to 0.9×10^{21} (n/cm^2, >1 MeV). Specimen temperatures were varied from 600 to 800°C. The irradiation accumulated 3207 hours. Data from these tests are presented and analyzed. (auth)

43418 (TRG-Report-2103(Add.)) MEASUREMENTS OF THE THERMAL CONDUCTIVITY OF URANIUM DIOXIDE AT 670 TO 1270^0K. ADDENDUM: A COMMENT ON SOME RECENTLY PUBLISHED WORK. Goldsmith, L. A.; Douglas, J. A. M. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). 8 Feb 1972. 4p. Dep. NTIS (U. S. Sales Only).

Measurements of the thermal conductivity of uranium dioxide have recently been published by van Craeynest and Stora (Centre d'Etudes Nucleaires at Fontenay-aux-Roses). The results have been interpreted by their authors as showing that the variation of conductivity with pore fraction is temperature dependent, whereas paragraph 10 of this Report earlier concluded that it was independent of temperature. Possible reasons for the discrepancy are considered. (auth)

43419 INTERACTION OF MOLYBDENUM TRIOXIDE WITH GRAPHITE. Pavlov, Yu. A.; Meshcheryakov, G. Ya.; Sheboldaev, S. B. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 1, 13-14(1972). (In Russian).

The effects of the distance between molybdenum trioxide and graphite specimens and the direction and flow rate of inert gas current on the oxide's sublimation rate were studied. The experiment involved specimens of analytically pure molybdenum trioxide, and MG-grade graphite, a quartz reaction vessel, and a resistance tube furnace. The testing temperatures were 400, 500, and 600°C and the reaction time was ½ h. It is shown that graphite, while adsorbing molybdenum trioxide vapors, reduces their partial pressure on the oxide and promotes sublimation. As the distance between the oxide and graphite specimens is increased, the sublimation rate decreases due to the drop in the concentration gradient of MoO_3 vapors from the oxide to the graphite. Here the concentration gradient acts as the motive force for the diffusion of oxide vapors. A decrease in the distance between the specimens raises this gradient, facilitating the uptake of vaporized molybdenum trioxide from the specimens, thereby promoting the sublimation rate. Increasing the inert gas flow rate promotes the graphite effect, facilitating vapor uptake and promoting sublimation. (JPRS)

43420 LOW-TEMPERATURE MECHANICAL PROPERTIES OF THORIA DISPERSION-STRENGTHENED IRON. Place, T. A.; Lund, J. A. (Univ. of British Columbia, Vancouver). Met. Trans.; 3: No. 6, 1613-19(Jun 1972).

The mechanical properties of iron, and iron containing a thoria dispersion in volume fractions of 0.9 and 1.7%, have been determined over the temperature range 77 to 373°K. Yield stress values for $Fe-ThO_2$ calculated from a modified Orowan relation were within 8% of the experimental values. A peak in work hardening rate was observed in the temperature range 250 to 300°K. The peak occurred at each of the selected strains, 1, 2, 4, and 8% and in all three materials. The work-hardening rates of the thoriated alloys remained roughly double that of iron at all strains. The particles were considered to increase the rate of dislocation multiplication, and have a strong but largely indirect effect on the work-hardening process. (auth)

43421 RELATIONS BETWEEN MECHANICAL PROPERTIES AND MICROSTRUCTURES IN $TiC-Mo_2C-Ni$ ALLOY. Suzuki, Hisashi; Hayashi, Kozi; Terada, Osamu (Tokyo Univ.). J. Jap. Inst. Metals; 36: No. 5, 514-18(May 1972). (In Japanese).

The transverse-rupture strength and the hardness of TiC-(10~30)%Mo_2C-(10~20)% Ni alloys were investigated in relation to the mean free path or the mean grain size of the carbide and the mean grain size of titanium carbide (occluded in the carbide). Various specimens with various microstructures were prepared by ball-milling and sintering at 1300 ~ 1450°C for 1 ~ 8 hr. It was found that transverse-rupture strength vs. mean free path curves showed a maximum in the same way as WC–Co alloy when the mean grain size of titanium carbide was kept constant. Hardness decreased linearly with increasing logarithm of mean free path, and it decreased also with increasing amount of Mo_2C. The mean grain size of carbide in sintered alloys seemed to be controlled, under a definite sintering condition, by the ratios of Mo_2C/Ni and TiC/Mo_2C. (auth)

43422 FLUORINATION KINETICS OF Nb_2O_5. Rakov, E. G.; Kopchikhin, D. S.; Sudarikov, B. N.; Gromov, B. V. This paper was summarized in At. Energ. (USSR); 31: No. 2, 137(Aug 1971) as paper No. 516/6082. (In Russian).

Full copy of this paper is held by TIC.

The kinetics of the interaction of pure powdery α-Nb_2O_5 and NbO_2F with elemental fluorine was studied by a gravimetric method over the temperature range from 330 to 430°C. It was found with the aid of chemical analysis and x-ray phase analysis, that two consecutive reactions occur in the fluorination of Nb_2O_5: $Nb_2O_5 + F_2 \rightarrow 2NbO_2F + \frac{1}{2} O_2$ and $NbO_2F + 2F_2 \rightarrow NbF_5 + O_2$, with the rate of the first reaction being much faster than the rate of the second, and the second acting as the rate-limiting process on the whole. Equations are given for the kinetics of the reactions of the two compounds studied. Calculations based on the theory of absolute reaction rates showed that the experimental fluorination rate of Nb_2O_5 at 350°C corresponded to the greatest extent to the theoretically predicted fluorination rate in two instances. (P.C.H.)

43423 SYNTHESIS AND KINETICS OF FORMATION OF NICKEL NIOBATE. Mkrtchyan, R. T.; Babayan, S. A.; Babayan, G. G. (Erevan State Univ.). Arm. Khim. Zh.; 24: No. 6, 473-7(1971). (In Russian).

Several compounds are formed in the system $NiO-Nb_2O_5$; four such compounds having NiO/Nb_2O_5 ratios of 1:1, 2:1, 3:1, and 4:1 were prepared for the oxides and subjected to x-ray diffraction analysis for comparison with the parent oxides and with each other. The kinetics of formation of the four compounds were studied at a series of temperatures ranging from 700 to 1,300°C. (K.S.W.)

43424 HTGR FUEL REFABRICATION DEVELOPMENT. Lotts, A. L.; Sease, J. D.; Wymer, R. G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 187-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43425 INFLUENCE OF GAS PRESSURE ON THE PERFORMANCE OF OXIDE-COATED PARTICLE FUELS. Stansfield, O. M.; Hudritsch, W. W.; Gulden, T. D. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 188-9 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43426 PLUTONIUM COATED-PARTICLES DEVELOPMENT. Bairiot, H. (Belgonucleaire SA, Brussels); Vangeel, J. Trans. Amer. Nucl. Soc.; 15: No. 1, 189-90(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43427 FABRICATION OF PLUTONIUM FUELS FOR HTGR. Sease, J. D. (Oak Ridge National Lab., Tenn.); Sanders, C. F.; Eatherly, W. P.; Harmon, D. P.; Scheffel, W. J. Trans. Amer. Nucl. Soc.; 15: No. 1, 190(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43428 IRRADIATION OF $TZM-UO_2$ AND TZM-UN PINS. McDonald, Glen E. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 1, 190-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43429 PREPARATION AND CHARACTERIZATION OF $NpO_2-CaO-ZrO_2$ TARGET RODS FOR ^{238}Pu PRODUCTION IN COMMERCIAL WATER REACTOR. Kruger, O. L.; Pardue, W. M. (Battelle-Columbus Labs., Ohio). Trans. Amer. Nucl. Soc.; 15: No. 1, 191-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43430 POSTIRRADIATION TOUGHNESS OF BATH SHIELD MATERIAL. Albertin, Leopold (Westinghouse Astronuclear

Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 1, 203-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43431 CRACK DAMAGE PARAMETERS IN IRRADIATED Cu–18 VOL. PERCENT ^{10}B CONTROL VANE MATERIAL. Albertin, L. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 1, 204-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43432 THERMAL EXPANSION OF PuO$_2$ FROM 25 TO 1420^{0}C. Tokar, M.; Nutt, A. W. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 210-11(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43433 VISCOSITY OF MOLTEN URANIUM DIOXIDE. Tsai, H. C.; Olander, D. R. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 15: No. 1, 211(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43434 THERMODYNAMIC AND DEFECT-STRUCTURE STUDIES IN (U,Pu) MIXED-OXIDE FUELS. Javed, N. A.; Roberts, J. T. A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 211-12(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43435 RE-SOLUTION OF GASEOUS FISSION PRODUCTS IN UO$_2$ IRRADIATED IN EBR-II. Dapht, M. J.; Pati, S. R.; O'Boyle, D. R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 212-13(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43436 RE-SOLUTION EFFECTS ON FISSION GAS BUBBLE DISTRIBUTION IN OXIDE FUELS. Poeppel, R. B.; Pati, S. R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 213-14(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43437 COLUMNAR GRAIN GROWTH IN OXIDE FUELS. Christensen, J. A. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 214-15(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43438 ACTINIDE REDISTRIBUTION IN MIXED-OXIDED FUELS IRRADIATED IN A FAST FLUX. Meyer, R. O.; Butler, E. M.; O'Boyle, D. R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 216-17(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43439 EVALUATION OF FAST-REACTOR-IRRADIATED BORON CARBIDE POWDERS. Copeland, G. L.; Yakel, H. L.; DuBose, C. K. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 246-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43440 ELECTRON MICROSCOPY OF FAST-REACTOR-IRRADIATED BORON CARBIDE. Jostsons, A.; DuBose, C. K; H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 247-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43441 VAPOR DEPOSITION OF ZIRCONIUM CARBIDE–CARBON COMPOSITES BY THE IODIDE PROCESS. Ikawa, K. (Japan Atomic Energy Research Inst., Tokai). J. Less-Common Metals; 27: No. 3, 325-32(Jun 1972).

Zirconium carbide–carbon composites have been deposited in a flow process from vapor species produced by the reaction between methyl iodide and zirconium sponge. Appreciable deposition occurred above 1000°C. Zirconium deposition and carbon deposition were found to be independent; the zirconium carbide phase is considered to be formed not by vapor phase reaction but by nucleation on the substrate. The C/Zr ratio in the deposition products depends on the carrier flow rate as well as on the reaction temperature and is also influenced by the deposition temperature. (auth)

43442 DISSOCIATION PRESSURES AND THERMODYNAMIC PROPERTIES IN THE SYSTEM CALCIUM HYDRIDE–LANTHANUM HYDRIDE. Messer, C. E.; Miller, R. J.; Phillips, T. J. (Tufts Univ., Medford, Mass.). J. Less-Common Metals; 27: No. 3, 371-81(Jun 1972).

The hydrogen dissociation pressures were measured as functions of composition and temperature for the system calcium–lanthanum–hydrogen at pressures from 50 to 760 Torr, and metal compositions X_{La} 0.500, 0.584, 0.733, and 0.873, X_{La} = atoms La/(atoms La + atoms Ca). The equilibrium pressures varied smoothly with metal composition in such a way as to indicate that the system is one of continuous solid solutions in this region. The room temperature x-ray diffraction patterns of the samples showed only the fcc phase for $X_{La} = 0.584$ and greater. Three preparations of $X_{La} = 0.500$ gave different sets of pressure isotherms, and also contained small amounts of CaH$_2$ phase. The enthalpies and entropies of solution $\overline{H}_H - \frac{1}{2}H^0_{H_2}$ and $\overline{S}_H - \frac{1}{2}S^0_{H_2}$ were of the same order of magnitude as for the LaH$_2$–LaH$_3$ system. Interaction energies between octahedral hydrogen and octahedral interstices, as evaluated by regular solution theory, changed smoothly from negative values toward positive values both with increasing temperature and with increasing calcium content. (auth)

43443 HIGH-TEMPERATURE SOLID-SOLUBILITY LIMIT AND PHASE STUDIES IN THE SYSTEM TANTALUM–OXYGEN. Jehn, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart); Olzi, E. J. Less-Common Metals; 27: No. 3, 297-309(Jun 1972).

The solid solubility limit of oxygen in tantalum was determined in the temperature range 1100 to 2500°C. The terminal solubility increased from 3 at. % O at 1100°C to 5.7 at. % O at 1880°C; the solubility line showed a slight kink at 1550°C and 5.1 at. % O. From the determinations of the terminal solubility and from quantitative metallographic examination of arc-melted alloys containing 20 to 70 at. % O a partial Ta–Ta$_2$O$_5$ phase diagram is proposed. The system showed a liquid immiscibility gap and hence a monotectic at 1880° ± 30°C with the equilibrium phases α-Ta(5.7 at. % O), liquid L_I($\approx$43 at. % O), and liquid L_{II}($\approx$65 at. % O). Liquid L_{II} decomposed by an eutectic reaction at 1550° ± 30°C with the equilibrium phases α-Ta (5.1 at. % O), L_{II}($\approx$71 at. % O), and Ta$_2$O$_5$. (auth)

43444 MICROHARDNESS OF NONSTOICHIOMETRIC SOLID SOLUTIONS BASED ON ZIRCONIUM AND NIOBIUM CARBIDES. Ordan'yan, S. S.; Dudryasheva, L. V.; Avgustinik, A. I. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 12, 1939-41(Dec 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 12, 2179-82(Dec 1971).

The effects of variable vacancy concentration in carbon atoms and atoms with different valences in metal sublattices on the microhardness of complex nonstoichiometric phases based on zirconium and niobium carbides were studied. The marked difference observed between the variation of the microhardness of ZrC- and NbC-based nonstoichiometric solid solutions is due to the difference between their electronic structures. (auth)

43445 PHASE EQUILIBRIA IN THE SYSTEM Ga$_2$O$_3$–Nb$_2$O$_5$. Fedorov, N. F.; Andreev, I. F.; Kasparyan, R. M.; Smorodina, T. P.; Parfenenkov, V. N. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 12, 1966-8(Dec 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 12, 2211-14(Dec 1971).

Investigations leading to construction of a phase diagram of the system Ga$_2$O$_3$–Nb$_2$O$_5$ are reported. The existence of the compounds GaNbO$_4$, GaNb$_{11}$O$_{29}$, and probably GaNb$_{49}$O$_{124}$, was established. Three invariant points were found corresponding to the compositions 65 mole % Nb$_2$O$_5$ + 35 mole % Ga$_2$O$_3$ (eutectic) along with 60 mole % Nb$_2$O$_5$ + 40 mole % Ga$_2$O$_3$ (peritectic), and 90 mole % Nb$_2$O$_5$ + 10 mole % Ga$_2$O$_5$ (peritectic) at 1375, 1425, and 1430°C, respectively. (auth)

43446 SYNTHESIS OF YTTRIUM AND EUROPIUM NIOBATES AND THEIR PHYSICOCHEMICAL PROPERTIES. Bondar, I. A.; Degen, M. G.; Koroleva, L. N. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 12, 1969-71 (Dec 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 12, 2215-17(Dec 1971).

Crystalline phases were prepared of compositions in the systems Y$_2$O$_3$–Nb$_2$O$_5$ and Eu$_2$O$_3$–Nb$_2$O$_5$: a berthollide phase Ln$_3$NbO$_7$ and lanthanide orthoniobate LnNbO$_4$. Single crystals of yttrium orthoniobate YNbO$_4$ have been grown. The microrelief of the faces of yttrium and europium niobate crystals has been studied. (auth)

43447 ELECTRON MICROSCOPE STUDIES OF FRACTURE SURFACES IN HARD METALS. Kohlhaas, Erich; Jung, Otto; Fischer, Alfred (Stahlwerke Roechling-Burbach GmbH, Voelklingen, Ger.). Prakt. Metallog.; 9: No. 5, 243-55(May 1972). (In German and English).

The crack path was traced in different hard metal alloys using electron microscope replicas. Coarse grained hard metals with low Co contents—4.5% Co—exhibited heavy plastic deformation both of the WC crystals and of the narrow veins of Co. The plastic deformation of the WC crystals was demonstrated by the numerous stacking faults, extended dislocation pairs and dislocation networks in the electron micrographs of foils. Plastically deformed WC crystals were observed less frequently in hard metals with higher cobalt content, and the Co phase was more involved in the crack path. The cleavage of large WC grains was common to all fracture surfaces. The crack starts at a site of stress concentration and can sometimes run across several adjoining carbides with the same orientation. Mixed carbides are particularly brittle and their appearance is similar in fibrous fracture. Plastic deformation was rarely observed. Hard metals with η-phases exhibited extensive smooth fracture surfaces without plastic deformation. Whereas the study of fracture surfaces clearly demonstrated the different fracture mechanisms occurring in different types of hard metals, no connection could be established between the mechanical properties and the appearance of the fracture in specimens of the same hard metals. Because of the brittleness of the material, ramification of the cracks on fracture leads to crumbling of the material so that the origin of the fracture no longer exists. Specimens with high and low bending strength can clearly be differentiated by macroscopic examination of the fracture but the high resolution electron micrographs show no basic differences in the fine structure. (auth)

43448 CHEMICAL COMPATIBILITY IN METAL-FIBER COMPOSITES. Staudhammer, K. P.; Murr, L. E.; Marinoff, C.; Reineking, V. (TRW Systems Group Inc., Redondo Beach, Calif.). Microstructures; 3: No. 4, 17-21(1972).

The various features of chemical compatibility or incompatibility of fiber-matrix composites, particularly the general problem of fiber degradation by chemical reaction with the matrix, and the inhibition of this process through the application of a suitably unreactive coating to the fiber prior to fabrication are discussed. Particular attention is given to a description of microanalytical techniques incorporating optical and electron microscopy, electron-probe microanalysis, and x-ray diffraction for the characterization of reaction-zone chemistry and microstructure for the Ti—B and Ti—SiC metal or alloy composite systems. On the basis of the experimental studies the following conclusions are presented: (1) diffusion couples and powder mixtures of fiber-matrix, fiber-coating, or fiber-coating-matrix systems are effective means of studying reaction products and kinetics utilizing x-ray diffraction in the main, supplemented by more detailed investigations using the electron microprobe or other more sensitive microanalytical techniques; (2) reaction products in the Ti—B composite system have been identified as principally Ti—B; (3) reaction products in the Ti—SiC composite system have been identified as primarily Ti_5Si_3 and TiC; with a complex gradation of equilibrium regions within the Ti—SiC interface reaction zone; and (4) the inhibition of SiC whisker degradation in Ti metal or alloy matrices by vapor-deposited Ag, Au, or Rh/whisker coatings appears to be effective up to 950, 1000, and 1100°C, respectively. The principal reaction products occurring as second-phase precipitates in the Ag—Ti, Au—Ti, and Rh—Ti systems can be identified in part from the corresponding phase diagrams. (auth)

43449 MICROSTRUCTURAL VIEW OF THORIA DISPERSION-STRENGTHENED NICKEL PRODUCTION. Kimmel, E. R.; Scheithauer, W. Jr. (Pennsylvania State Univ., University Park). Microstructures; 3: No. 4, 11-15(1972).

In recent years, much interest has been generated in oxide dispersion-strengthened alloys owing to their unusually good mechanical strengths at elevated temperature. The presence of the oxide dispersoid phase will not in itself, provide the substantial high-temperature mechanical properties normally associated with these alloys. These properties are strongly influenced by the state of the dispersoid distribution and that of the metal matrix. The powder metallurgical production methods, used to manufacture these alloys, have a major role in producing the optimum microstructures necessary for the desired high temperature properties. The microstructural features of major interest in oxide strengthened alloys, the oxide dispersion and matrix substructure, require the resolution of the transmission and scanning electron microscopes. Examples of how the production methods used to manufacture thoria-dispersed nickel affect the desired microstructural constituents are discussed, and microstructural variations from initial powder to final sheet forms are illustrated. (auth)

43450 METHOD OF MANUFACTURING POROUS ARTICLES CONSTRUCTED OF SILICON CARBIDE OR MATERIALS HAVING A SILICON CARBIDE BASE. Couach, Michel (to Commissariat a l'Energie Atomique). French Patent 2,068,161. 26 Jul 1971. Filed 28 Nov 1969. (In French).

A method of manufacturing porous silicon carbide articles is described. A carbon based matrix with a density between 1.4 and 1.5 g/cm^3 and having the form of the article desired is prepared. The matrix is heated under vacuum to a temperature in the vicinity of that of the Si bath in which it is subsequently immersed. The impregnated matrix is brought into contact with a very porous piece of graphite in order to eliminate the superfluous Si. The matrix is then destroyed by oxidation at a temperature between 600 and 800°C. Such articles have applications in reactor structure elements and catalyst supports. (France)

43451 NIOBIUM CARBIDE COATINGS ON STEEL AND CERMET HARD ALLOYS. Minkevich, A. N.; Serebrennikova, V. S.; Kuznetsov, G. D. (Moscow Inst. of Railroad Transportation Engineers). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 13: No. 11-12, 1032-4(1971).

Translated from Metalloved. Term. Obrab. Metal.; 13: No. 12, 38-40(Dec 1971).

A technique was developed for obtaining an even coating of niobium carbide (up to 50 μ thick, H = 2099) with good adherence to the substrate. Samples of U7 steel and cutters of cermet alloy VK-8 with niobium carbide coatings had a high wear resistance. Coatings of niobium carbide cost less than coatings of titanium carbide and can be obtained with less complicated apparatus. Thus, niobium carbide coatings can compete with titanium carbide coatings in many applications. (auth)

43452 SOME PHYSICAL PROPERTIES OF BERYLLIUM, CHROMIUM, AND LANTHANUM BOROCARBIDES. Neshpor, V. S.; Vekshina, N. V.; Nikitin, V. P.; Markovskii, L. Ya. (State Inst. of Applied Chemistry, Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 12, 1931-4(Dec 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 12, 2170-4(Dec 1971).

Conditions were studied for obtaining the borocarbides Cr_7BC_4, BeC_2B_2, BeC_2B_{12}, LaBC, LaC_2B_2, and LaC_4B_2 by synthesis from the components, and the conditions for obtaining compact specimens of these compounds by hot pressing. The electrical and thermal conductivities, thermo-emf, magnetic susceptibility, hardness and (approximately) the melting points of Cr, Be, and La borocarbides were measured. Chromium borocarbide has a metallic character, the higher beryllium borocarbide BeC_2B_{12} is a semiconductor with properties similar to boron carbide, whereas the borocarbides BeC_2B_2, LaC_2B_2, and LaC_4B_2 are apparently semimetals. (auth)

43453 Ta—O SYSTEM: HIGH TEMPERATURE SOLID SOLUBILITY. Jehn, H. (Max-Planck Inst. for Metallurgy, Stuttgart); Olzi, E. Met. Ital.; 62: No. 10, 381-4(Oct 1970). (In Italian).

The solubility limit of oxygen in tantalum was determined in a temperature range of 1000 to 2500°C. The solubility curve showed a peak at 1550 ± 30°C. These results and further metallographic investigations showed the co-existence of a new phase in equilibrium with the α solid solution at temperature above 1550 ± 30°C. (auth)

43454 SYSTEMATICS OF THE PROPERTIES OF CUBIC REFRACTORIES. Merz, Alfred (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Neue Huette; 17: No. 1, 7-12(Jan 1972). (In German).

Because of their high degree of symmetry, refractory materials with cubic structure permit theoretical predictions about several of their properties. Discrepancies, however, still exist between practical experience and theoretical concepts. These discrepancies originate from insufficient purity of the experimental material, ordering processes, and oversimplification of theoretical approaches. The direction in which theoretical concepts must be improved is exemplified by modern calculations based on the band model and density of TiC. (tr-auth)

43455 ENERGY OF BONDING OF SURFACE OXYGEN IN THE VANADIUM(V)—MOLYBDENUM(VI) OXIDE SYSTEM (V_2O_5—MoO_3). Gol'dshtein, N. D.; Mishchenko, Yu. A.; Gel'bshtein, A. I. (Physical-Technical Inst., Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 58-60(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 106-10(Jan 1972).

The isotopic exchange of oxygen on the surfaces of the individual oxides V_2O_5 and MoO_3 and their mixed compositions has been studied after various pretreatments. Oxides having a non-equilibrium content of oxygen in the surface layer under the conditions of exchange are distinguished by enhanced activity towards exchange, and the oxygen undergoing exchange is itself energetically non-uniform. With oxides of equilibrium oxygen content, the oxygen is uniform with respect to exchange. On passing from vanadium pentoxide to molybdenum trioxide in the V_2O_5—MoO_3 system, the energy of bonding of oxygen shows initially a considerable increase in the range of solid solutions of molybdenum trioxide in vanadium pentoxide, after which it decreases slightly in the range of existence of the chemical compound $Mo_4V_6O_{25}$. (auth)

43456 CHEMICAL VAPOR DEPOSITION OF TUNGSTEN CARBIDE DENDRITES. Takahashi, Takehiko; Itoh, Hideaki (Nagoya Univ., Japan). J. Cryst. Growth; 12: No. 4, 265-71 (Apr 1972).

Tungsten carbide was obtained by chemical vapor deposition from a mixture of WCl_6, C_3H_8, H_2, and Ar on a graphite substrate in the temperature range of 1200 to 1500°C. The influence of various factors on the crystal growth was investigated. The geometry in the furnace proved to be an important factor for the process of crystallization. The adherent coating of α-W_2C could be obtained at relatively high flow rates of H_2 and WCl_6. The appropriate gaseous concentrations for the growth of WC were as follows: WCl_6: 1.0 to 1.5 mole%; C_3H_8: 1.7 to 2.8 mole%; H_2: 10 to 20 mole%; and Ar: 75 to 85 mole%; and the total flow rate was 1.78 ml/sec. Various crystal morphologies composed of uniform films, networks, dendrites, and pillars with diameters of 2 to 40 μm were deposited on the WC-plated graphite. The dendritic or pillar crystals were obtained at temperatures between 1250 and 1400°C, while the network-like crystals were formed at lower temperatures of 1200 to 1300°C on the substrate surface. (auth)

43457 HIGH-TEMPERATURE GRAPHITE PROTECTIVE COATINGS. Mashnitskii, A. A.; Andreeva, T. V.; Dubovik, T. V. (Inst. of Material Physics Problems, Kiev). Refractories (USSR) (Engl. Transl.)· 12: No. 11-12, 728-30(1971).

Translated from Ongneupory; 12: No. 11, 41-4(Nov 1971).

Studies were made on the conditions for obtaining protective coatings of boron nitride on graphite products for increasing their corrosion resistance. A technology was developed for applying coatings of boron nitride on graphite by nitriding graphite products in a batch of 80% H_3BO_3, 15% BN, and 5% carbon in a tubular graphite resistance furnance with heating elements of diameter 90 mm, and from 50% H_3BO_3 and 50% BN with an element diameter of 150 mm. A mechanism is proposed for the formation of the coating. The possibility of using graphite products coated with BN for melting semiconductor materials: silicon, germanium, and alloys of these two was demonstrated. Graphite products coated with boron nitride combine the valuable characteristics of graphite and boron nitride which makes it possible to greatly extend the region of application of these materials. (auth)

43458 EFFECT OF SPECIMEN DENSITY ON THE DEGREE OF NONSTOICHIOMETRY OF ZIRCONIA FIRED IN VACUUM. Andreeva, N. A.; Kozlovskii, L. V. (Leningrad Inst. of Tech.). Refractories (USSR) (Engl. Transl.); 12: No. 11-12, 738-9(1971).

Translated from Ogneupory; 12: No. 11, 50-2(Nov 1971).

Since the deviation of the stoichiometric ratio of the composition is directly connected with the volatilizing surface, studies were made to determine if the density of the specimen affects the breakdown of the stoichiometric composition of the zirconium oxide. The specimens were fired at 2100, 2300, and 2400°C with soaks of 1 and 3 h. The results showed that the higher the initial density of the specimens the greater the deviation from stoichiometry in the zirconium dioxides. The effect can be explained by taking into account the effect of diffusion processes in solid phases. Also, during pressing a certain part of the energy apparently is spent on some deformation of the crystal structure of the oxides. (P.C.H.)

43459 EFFECT OF SHOCK WAVES ON THE STRUCTURE OF REFRACTORY CARBIDES. Samsonov, G. V.; Alekseevskii, V. P.; Bozhko, S. A.; Yarosh, V. V. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 74-9(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 93-100(Jan 1972).

Studies were made on the effects of shock waves on the structure of hot-pressed specimens from powders of Ti, Zr, and Nb carbides in their homogeneity regions, and an attempt was made to obtain dense specimens of these carbides from powders by explosive pressing. High porosity in Ti and Zr carbides resulted in the formation of a network of microcracks during explosive pressing. With decrease in carbon content, the microcracks became less numerous. In niobium carbide phases, few microcracks were formed, mainly at grain boundaries. Shock compression, in addition to giving rise to microcrack generation, must also result in plastic deformation in local volumes of carbides. Evidence in support of this contention was provided by both increased microhardness and line broadening in x-ray diffraction pictures of the carbides investigated after explosive pressing. In the pressing of powders in cylindrical containment capsules, the density of specimens was found to be nonuniformly distributed over their cross section. Specimens tended to be more porous in the center and frequently had a cylindrical axial cavity with radial cracks emanating from it. The density level attained was virtually independent of the pressure in the explosive detonation because the explosion energy of a propellant charge greatly exceeded the work of densification. The fine structure, plastic behavior, and electronic structure of the carbides are also discussed. (P.C.H.)

43460 CONDITIONS OF FORMATION AND SOME PROPERTIES OF ZIRCONIUM OXYCARBIDES. Kosolapova, T. Ya.; Fedorus, V. B.; Panasyuk, A. D.; Kozina, G. K. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 47-50(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 60-4(Jan 1972).

Attempts were made to study the mutual solubility limits of zirconium carbide and zirconium monoxide and also the boundaries of existence and some properties of single-phase zirconium oxycarbide. The reaction between $ZrC_{0.98}$ and ZrO_2, taken in various proportions, was investigated at a temperature of 2000°C and a pressure of ~10 mm Hg. X-ray, structural, chemical, and metallographic methods were used. The results showed that, at ZrO_2 contents below 20 mole %, single-phase reaction products were obtained ranging in composition from $ZrC_{0.90}O_{0.05}$ with the lattice constant a = 4.688 Å to $ZrC_{0.71}O_{0.28}$ with the constant a = 4.659 Å. At 20% ZrO_2, after reaction the starting mixture contained ZrO_2 and the oxycarbide $ZrC_{0.7}O_{0.3}$. Thus, the zirconium oxycarbide composition $ZrC_{0.7}O_{0.3}$ is a limiting one, corresponding to mutual solubilities, under the conditions investigated, of ~56% ZrC and ~44% ZrO_2, which means that the maximum solubility of oxygen in zirconium carbide at 2000°C does not exceed 15 at. %. Absorption spectra was used to confirm the existence of oxycarbides. It was concluded that the oxycarbides have better resistance to liquid transition metals, especially liquid cobalt, than zirconium carbide, and because of this must be regarded as potentially useful refractory materials. (P.C.H.)

43461 SINTERING AND SOME PROPERTIES OF YTTRIUM OXIDE OBTAINED BY DECOMPOSING THE CARBONATE AND HYDROXIDE OF YTTRIUM. Borovkova, L. B.; Lukin, E. S.; Poluboyarinov, D. N.; Snegireva, N. N. (Inst. of Chemical Tech., Moscow). Refractories (USSR) (Engl. Transl.); 12: No. 11-12, 780-5(1971).

Translated from Ogneupory; 12: No. 12, 26-31(Dec 1971).

Yttrium carbonate, $Y_2(CO_3)_3$, and yttrium hydroxide, $Y(OH)_3$, were decomposed, and the sintering of the resulting Y_2O_3 was studied along with the thermal and mechanical properties. The results showed that powders of Y_2O_3, active in relation to sintering, can be obtained by decomposing yttrium carbonate at 600 to 700°C. Even at 1700°C the relative density of the articles made from this material reached 97 to 98%. A high density in ceramics made from special purity Y_2O_3 can be achieved at 2000°C. Consequently, the use of Y_2O_3 powder obtained from the yttrium carbonate allowed a reduction in the sintering temperature of approx mately 300°C. The properties of the Y_2O_3 ceramics obtained from the carbonate and special-purity Y_2O_3 were in practice hardly distinguishable. (P.C.H.)

43462 PHASE COMPOSITION, MICROSTRUCTURE, AND PROPERTIES OF MATERIALS BASED ON THE ZrO_2–Nd_2O_3 SYSTEM. Strakhov, V. I.; Klyucharov, Ya. V.; Sergeev, G. G. (Leningrad Inst. of Tech.). Refractories (USSR) (Engl. Transl.); 12: No. 11-12, 800-4(1971).

Translated from Ogneupory; 12: No. 12, 43-7(Dec 1971).

Studies were made on the effects of the phase composition and microstructure of the calcination products of compositions ZrO_2–Nd_2O_3 on the properties of zirconium refractories, and primarily on their thermal-shock resistance. The results showed that complete bonding of ZrO_2 into a cubic solid solution at 1750°C with a 4 h soak was achieved by adding 12% (mole) Nd_2O_3. The ZrO_2–Nd_2O_3 had a very high resistance to decomposition, which was preserved in the presence of nonstabilized ZrO_2. By regulating the microstructure of the fired products of composition ZrO_2–Nd_2O_3 it was possible to obtain zirconia refractories with an increased thermal-shock resistance. (P.C.H.)

43463 COMMINUTION CHARACTERISTICS OF ZIRCONIUM DIBORIDE. D'yakonova, L. V.; Kislyi, P. S. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 1-4(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 1-5(Jan 1972).

The investigation into the comminution kinetics of zirconium diboride powder has demonstrated that comminution is more effective in a vibratory mill than in a ball mill. The optimum comminution time is 2 to 3 h. Tsyurupa's analytical method of calcul tion can be employed for determining the particle-size distributio of powders. Of the dispersing media investigated, ethyl alcohol gave the most agglomeration-resistant zirconium diboride suspensions. Of the analysis methods examined, sedimentation analysis provided the fullest information on powder dispersion characteristics, but the most reliable values of mean particle size were obtained by the gas—stream ratio method. (auth)

43464 SOLID-PHASE REACTIONS IN COBALT—CARBIDE SYSTEMS. Petrova, E. M.; Shcherban, N. I. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 28-32(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 35-40(Jan 1972).

An investigation was made into the kinetics of diffusion layer growth during the reactions of titanium, zirconium, niobium, chromium, molybdenum, and tungsten carbides with cobalt. It was observed that with rise in temperature reactive diffusion begins to take place in the systems investigated. It was found that a correlation exists between the parameters n and Q, which characterize reactive diffusion processes, and the thermodynamic characteristics of carbides: The greater the thermodynamic stability of these compounds, the higher are the values of n and Q. (auth)

43465 APPLICATION OF A SCANNING ELECTRON MICROSCOPE FOR THE ANISOTROPY DETERMINATION OF PYROCARBON. Suzuki, Hiroshige; Iseki, Takayoshi; Hase, Teizo; Wakashima, Yoshikazu (Tokyo Inst. of Tech.). Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 109, 105-12(Mar 1972).

Microspheres of (U, Th)C_2, (U, Th)O_2 or UO_2 coated with pyrocarbon have been used in high-temperature gas-cooled reactors as fuel elements. In such fuel elements, the pyrocarbon coating is employed to retain fission products and to minimize fission product contamination in the helium coolant. Since the in-pile behavior of such pyrocarbon layers has a significant relationship with performance of fuel elements, the effects of fabrication processes on radiation damage have been intensively investigated. Many studies in this field have made it clear that isotropic property is the most important for the pyrocarbon coating layer, and that a density of approximately 1.9 g/cm^3 is also required. The pyrocarbon coating is generally formed in fluidized bed by highly controlled processes. Since the process must supply products having consistent quality, practical methods must be developed for quality control. The Bacon anisotropy factor (BAF) of the pyrocarbon, which shows anisotropy or the degree of preferred orientation, has been indirectly determined on a plate deposited simultaneously with microspheres. Direct determination of BAF of the pyrocarbon coating layer on microspheres is now under investigation. Because of their importance, the structures of anisotropic pyrocarbon coatings formed from propane and high-density isotropic pyrocarbon coatings from methane were observed with a scanning electron microscope in relation to their BAF. The possibility for the direct determination of the anisotropy of the pyrocarbon coating layer on coated particle fuels was discussed. (Japan)

43466 STUDY OF THE SOLID SOLUTION REGIONS IN THE SYSTEM Zr—Te. Jenkins, Frances Dolores. Rolla, Mo.; Univ. of Missouri (1972). 286p. University Microfilms Order No. 72-18,199.

Thesis.

Relative intensity measurements of x-ray powder-diffraction lines were made of compositions in the region $ZrTe_{0.5}$ to $ZrTe_{2.0}$, fired between 600 and 817° in evacuated sealed tubes. The experimental relative intensities of samples between ZrTe and $ZrTe_2$ were compared with values calculated for several theoretical models with different Zr vacancy-ordering schemes and Te vacancy concentrations. The most probable structural model for compositions in the range ZrTe to $ZrTe_{1.5}$ is one in which the number of Zr vacancies located at $z = 0$ ranges from 0 to 30%, with the concentration of Te vacancies ranging from 0 to 35%. A structural model of 15% Zr vacancies at $z = 0$ and Te vacancy concentrations of 0 to 5% is proposed for compositions in the range $ZrTe_{1.5}$ to $ZrTe_2$. X-ray results indicate a two-phase region between $ZrTe_{0.7}$ and $ZrTe_{1.3}$ in the temperature range from 650 to 817°C. The phases are hexagonal Zr_4Te_3 and a ZrTe—$ZrTe_2$ superlattice. Two-phase material, with a mean composition of $ZrTe_{1.55}$, was observed visually in other samples fired at 600 and 817°C. All the tellurides reacted with atmospheric moisture at room temperature. (Diss. Abstr. Int., B)

43467 PLASMA PROCESS FOR ZIRCONIUM DIOXIDE. Wilks, P. H. (Ionarc/TAFA, Bow, N. H.); Ravinder, P.; Grant, C. L.; (and others). Chem. Eng. Progr.; 68: No. 4, 82-3(Apr 1972).

The process developed is based on the observation that zircon sand, $ZrSiO_4$, if heated to a sufficiently high temperature, dissociates into a zirconium dioxide (zirconia) rich phase, and a silicon dioxide (silica) rich phase. The plasma treatment produces a zirconia rich phase containing less than 0.5% silica. The silica rich phase is correspondingly low in zirconium. This separation is thought to result from the combination of ultra-high temperature and rapid quench to which the zircon particles are subjected. Subsequent to plasma treatment, sodium hydroxide is used to leach the silica, leaving zirconia behind. (J.R.D.)

43468 SYSTEM Ce—Fe—B. Bilonizhko, N. S.; Kuz'ma, Yu. B. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 163-4(Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 183-4(Jan 1972).

The phase composition of alloys of the system Ce—Fe—B was investigated by x-ray structural analysis and in some cases microstructural analysis for 93 specimens obtained by melting a charge (3 to 5 g) of compact cerium (99.56%), iron carbonyl powder (99.98%), and finely crystalline boron powder (99.4%). The results showed that ternary compounds are formed in the system as in the case of the Ce—Ni—B system. It is characteristic that in both systems all the compounds are formed in the region below 33.3 at. % Ce. However, a comparison of the x-ray diffraction patterns of ternary compounds in the systems Ce—Fe—B and Ce—Ni—B revealed the absence of isostructural compounds in these systems. (P.C.H.)

43469 SOLID-PHASE REACTION OF SAMARIUM AND CHROMIUM OXIDES. Rubinchik, Ya. S.; Mochal'nik, I. A.; Pavlyuchenko, M. M. (Inst. of General and Inorganic Chemistry, Minsk). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 114-16 (Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 133-6(Jan 1972).

The value of the activation energy determined and the dependence of the reaction rate on the type of crystalline structure of Sm_2O_3 indicated that a specific role in the reaction of these oxides is played by surface diffusion of the reagents, effected primarily by migration of samarium oxide. (auth)

43470 FORMATION OF SOLID SOLUTIONS AND COMPOUNDS IN THE SYSTEM Nd_2O_3—ZrO_2. Krzhizhanovskaya, V. A.; Glushkova, V. B. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 109-13(Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 127-32(Jan 1972).

Studies were made on the reactions of Nd_2O_3 with ZrO_2 in mixtures of different molecular compositions during high-temperature synthesis. The rate constants of the reaction of these oxides were determined, and the apparent activation energies were calculated. The presence of intermediate phases as well as the end products has been established. The formation constants of the intermediate and end products in a stoichiometric mixture (33.3 mole % Nd_2O_3 + 66.7 mole % ZrO_2) have been determined, and their apparent activation energies calculated. (auth)

43471 CRYSTAL STRUCTURE OF ZIRCONIUM OXYCARBIDES IN THE SYSTEM ZrC—ZrO_2. Gropyanov, V. P.; Kovalevskaya, T. A.; Razumovskii, S. N. (All-Union Inst. of Refractories, Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 77-80(Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 92-5(Jan 1972).

An increase in the ZrO_2 content of the initial charge reduced the lattice constant of the oxycarbides formed in ZrC—ZrO_2. With a brief residence time (up to 4 h), the formation kinetics of oxycarbides favored occurrence of the lattice constant minimum at the initial composition of 3 : 1. An increase of the roasting temperature equalized the reaction rates in the different compositions; therefore the oxycarbides obtained at 2420°K had similar lattice constants in the range 4.665 to 4.670 Å. An increase in the isothermal holding time at 2320°K reduced the lattice constant of oxycarbides. The rate of change of the lattice constant was maximal for the 1 : 1 composition and decreased with increasing ZrC content of the initial composition. Decomposition of zirconium oxycarbides under vacuum roasting conditions with formation of α-Zr(C, O) was accomplished by an inflection on the curves of the lattice constant versus residence time. The results of chemical and phase analyses permitted the empirical formula composition and the formulas of the zirconium oxycarbides obtained to be calculated, without taking account of the concentration of stoichiometric vacancies. (auth)

43472 STABILITY OF OXYCARBIDES IN THE SYSTEM ZrC—ZrO_2. Gropyanov, V. M.; Kovalevskaya, T. A.; Yudin, B. F. (All-Union Inst. of Refractories, Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 73-6(Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 88-9qan 1972).

A thermodynamic analysis and an experimental investigation have established that in cases where the partial pressure of CO in the system Zr—C—O does not correspond to the equilibrial partial pressure of CO, ternary phases of variable composition ZrC_xO_y and probably other oxycarbides are thermodynamically unstable phases. (auth)

Metals and Alloys

Refer also to abstract 44655.

43473 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Mai 1972. Band 6, Heft 5. 154 Referate (Register-Nr.1393-1657), 65 Referate (Register-Nr.339T-403T). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. May 1972. Vol. 6, No. 5. 154 Abstracts (Register No. 1393-1657), 65 Abstracts (Register No. 339T-403T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H (1972). 98p. (In German and English).

Corrosion and Erosion

Refer also to abstracts 42751 and 42889.

43474 (ANL–7916) SODIUM TECHNOLOGY QUARTERLY REPORT, OCTOBER–DECEMBER 1971. Kesser, G. M. (comp. and ed.) (Argonne National Lab., Ill.). May 1972. Contract W-31-109-eng-38. 69p. Dep. NTIS.

The research, development, and management efforts of Argonne National Laboratory's Sodium Technology Program for the period October–December 1971 comprised activities in the following areas: (1) In the national meter program, performance-characterization of an improved electrochemical oxygen meter has emphasized meter calibration using the vanadium-wire equilibration method for determining oxygen activity; other work has included testing of on-line monitors for hydrogen and leak detectors for steam generators, development of a method for relating the outputs of carbon meters to the carbon activity of sodium, and testing of meter modules for FFTF. (2) In the analytical standards program, efforts continued on the preparation of RDT standards relating to specifications for measuring and controlling the purity of sodium and cover gas; laboratory work included further studies of the effect of line length on the validity of sodium samples, evaluation of the uranium-getter method for determining oxygen in sodium, characterization of particulates filtered from various sodium systems, and development of methods for determining oxygen and hydrogen activities in sodium by the equilibration of niobium wires. (3) Development work was continued on a gas-chromatographic method for separating ^{23}Ne from noble-gas fission products in cover gas, a sparging technique for monitoring the ^{135}I content of reactor primary sodium, and an on-line diffusion meter for monitoring tritium in sodium. (4) Studies of the chemistry of liquid sodium have been directed toward investigations of oxygen–hydrogen interactions in sodium using deuterium as a stand-in for hydrogen, and evaluation of vacuum distillation as a means of determining oxygen, hydrogen, and nitrogen in sodium. (5) A program is under way to determine the integrated effects of fast-neutron and sodium environments on the properties of stainless steel, to develop postexposure testing methods for the stainless steel specimens, and to correlate the results from experimental and reactor sodium systems; work has continued on the study of carbon transport in sodium-steel systems. (auth)

43475 (RD/B/N–1930) CARBON BEHAVIOUR IN SODIUM SYSTEMS. PART I. A REVIEW OF CHEMICAL ASPECTS. Habdell, M. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jul 1971. 26p. (CFR-BMWP-P–71-32). Dep. NTIS (U. S. Sales Only).

It would be desirable in a sodium cooled reactor to measure and control carbon levels in the sodium, thus minimizing carburization of stainless steel components such as the fuel clad or thermal insulation around the core, and effecting decarburization of low alloy ferritic steels in the secondary system. This requires basic knowledge of carbon behavior in liquid sodium. The status of technology concerning the chemistry of sodium and carbon is described and information gained over the past twenty years on carbon transfer in liquid sodium systems is reviewed. (auth)

43476 INFLUENCE OF OXIDES ON THE MATERIAL TRANSFER AND THE EROSION CHARACTERISTICS OF SILVER BASE CONTACTS CONTAINING VARIOUS METAL OXIDES. Sato, Mitsunori; Hijikata, Masayuki; Morimoto, Ichiro (National Research Inst. for Metals, Tokyo). J. Jap. Inst. Metals; 36: No. 5, 410-18(May 1972). (In Japanese).

The silver base contacts containing magnesium, aluminum, manganese, zirconium, and cadmium oxides were prepared by internal oxidation. The material transfer and the erosion characteristics of these contacts have been measured in a range of applied voltages from 40 to 212 volts and short circuit currents from 6.4 to 80.1 amperes in direct current, alternating current and full wave rectification circuits. The characteristics of material transfer and erosion for switching contacts in the direct current and the alternating current circuits can be clarified mostly by a switching test of the full wave rectification circuits. In the switching of the full wave rectification circuit, the direction of material transfer depends on the circuit current. In the region of lower circuit currents than the critical current materials transfer from cathode to anode, and in the higher circuit current region materials moves from anode to cathode. The direction of material transfer and the amount of erosion are affected remarkably by the oxides contained, and depend on the materials of electrodes on the erosion side. In the region where materials transfer from cathode to anode in the direct current and the full wave rectification circuit, the amount of cathode loss is approximately proportional to the arc energy in contact breaking at constant voltage. On the other hand, the ratio of the amount of material transfer or erosion to the arc energy in contact breaking varies with oxides contained. (auth)

43477 PRIMARY HYDRIDE FAILURE OF ZIRCALOY-CLAD FUEL RODS. Joon, K. (OECD Halden Project, Norway). Trans. Amer. Nucl. Soc.; 15: No. 1, 186-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43478 HASTELLOY N ALLOYS AFTER NINE YEARS EXPOSURE TO A MOLTEN FLUORIDE SALT. Koger, J. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 227(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43479 STABILITY OF NITRIDED TYPE 304 STAINLESS STEEL IN HIGH-TEMPERATURE SODIUM. Bagnall, C.; Cowgill, M. G.; Schrock, S. L. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 234-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43480 COMPATIBILITY OF BRAZES WITH LIQUID METALS AND MOLTEN SALTS. Cole, N. C.; Hendricks, J. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 237-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43481 LIQUID SODIUM CORROSION OF REFRACTORY METALS AND ALLOYS BASED ON VANADIUM, NIOBIUM, AND TANTALUM. Borgstedt, Hans Ulrich; Frees, Guenter (Nuclear Center, Karlsruhe, Ger.). Rev. Coatings Corros.; 1: No. 1, 43-74(1972).

According to Mott's law the elements of the 5th group of transition metals have a low solubility in liquid sodium. Apparent corrosion reactions are caused by non-metallic impurities dissolved in the alkali metal. Among the elements oxygen, nitrogen, carbon, and hydrogen, oxygen is the most important with regard to corrosion phenomena. The metals and alloys of this group of transition metals suffer penetration by the nonmetallic elements, internal oxidation, oxide scale formation and spallation or dissolution of oxides, and in special cases, alkali metal penetration. Internal penetration can be reduced by the addition of special alloying elements. To suppress scale formation and weight losses caused by scale spallation or dissolution, the sodium must be purified to a very high degree. Of importance for the technical use of these metals and their alloys is the total amount of non-metallic elements present in the system as well as the mass proportion of metals to sodium. In sodium circuits, which are constructed to prevent large-scale transfer of interstitial elements, sodium corrosion does not limit the use of selected alloys based on these metals with their great possibilities for high-temperature technology and nuclear application. (auth)

43482 DIFFERENT MODES OF OXIDATION OF ZIRCONIUM DIBORIDE. Lebugle, Albert; Montel, Gerard (Univ., Toulouse). Compt. Rend., Ser. C; 274: No. 17, 1512-15(24 Apr 1972). (In French).

The oxidation of zirconium diboride between 520 and 620°C gives rise to a film of amorphous zirconia stabilized with boric oxide. This film is then transformed into crystallized nonprotected zirconia. The crystallized zirconia is obtained directly from the oxidation of the diboride at temperatures higher than 650°C and may form a protective coating. A transition region occurs for the two processes between 620 and 650°C. (France)

43483 KINETIC STUDY OF THE INITIAL OXIDATION OF A Ta(110) SURFACE USING OXYGEN K_α X-RAY EMISSION. Sewell, Peter B.; Mitchell, Don F.; Cohen, Morris (National Research Council of Canada, Ottawa). Surface Sci.; 29: No. 1, 173-88(Jan 1972).

The application of reflection high-energy electron diffraction (RHEED) and electron-excited x-ray emission to the study of the initial stages of oxidation of the Ta(110) surface is demonstrated. Oxidation in both dry oxygen and water vapor is investigated over a temperature range of 25 to 275°C and a pressure range of 10^{-7} to 1 torr. In dry oxygen, the thickness (y) of the uniform amorphous oxide is a function of the oxygen exposure in langmuirs (L) and its growth can be described by the logarithmic relation $y = k_1 \log(L + L_0) + k_2$, where $k_1 = 1.09 \pm 0.07 \times 10^{-8}$ g/cm^2, $k_2 = 1.3 \pm 0.3 \times 10^{-8}$ g/cm^2 and $L_0 = 1$ L. The growth of oxides up to 8 Å was observed with dry oxygen exposures of about 10^9 L. Thicker films grow in the presence of water vapor and films formed after chemical polishing and short periods of atmospheric exposure were found to be 35 ± 5 Å mean thickness. Problems associated with the preparation of the Ta(110) surface in a ''clean'' starting condition are discussed, particularly with reference to the formation of precipitated oxygen structures and the adsorption of background carbon monoxide on ''oxygen-free'' surfaces. (auth)

43484 STRESS-CORROSION SENSITIVITY OF SILVER-RICH SILVER–CADMIUM AND SILVER–ZINC ALLOYS AND BRASS IN $FeCl_3$ AND $Fe_2(SO_4)_3$ SOLUTIONS. Graf, Ludwig; Wieling, Norbert (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 63: No. 7, 379-83(Jul 1972). (In German).

The stress-corrosion sensitivity of silver-rich silver-zinc and silver-cadmium alloys and of α-brass in $FeCl_3$- and $Fe_2(SO_4)_3$-solutions was studied as a function of zinc and cadmium concentration. Its cause is explained on the basis of facts previously determined for other stress-corrosion-sensitive solid solutions. It thereby becomes clear why the stress-corrosion sensitivity of these alloys first arises at higher zinc and cadmium contents. (auth)

43485 DEVELOPMENT OF ABRASION- AND CORROSION-RESISTANCE ALLOYS FOR USE IN AQUEOUS MEDIA. Davin, A.; Coutsouradis, D. Cobalt; No. 52, 160-1(Sep 1971).

A study was made to determine whether the single or combined additions of 18% Ni, 9% Mo, and/or 4% Cu would improve the abrasion- and corrosion-resistance of a Co–2.2%C–32%Cr–13%W alloy, e.g. in plant for the production of superphosphates. Weight losses in 10% H_2SO_4, in $H_2SO_4-P_2O_5-Hf$ solution, and in a stirred suspension of corundum in the solution were determined. The Mo addition produced marked improvements, further additions of Cu and Ni improved the corrosion resistance without adversely affecting the enhanced abrasion resistance due to the Mo. (Metals Abstr.)

43486 SINTERED MAGNESIUM COMPOSITES AS CLADDING MATERIAL FOR URANIUM FUEL ELEMENTS COOLED BY CARBON DIOXIDE. PART III. CORROSION OF MAGNESIUM COMPOSITES IN CARBON DIOXIDE. Splichal, Karel (Nculear Research Inst., Rez, Czech.); Cech, Bohuslav. Jad. Energ.; 18: No. 6, 186-93(Jun 1972). (In Czech).

The corrosion resistance of magnesium systems with oxide, fluoride, and berillide admixtures was studied in moistened carbon dioxide at 500 to 550°C and pressures 1 and 60 atm abs. For purposes of comparison, pure magnesium and magnesium-alloys were examined simultaneously with the Mg composites. The relationship between the weight gains measured during the long-time tests and composition of materials was investigated. The mechanism of surface oxide film growth was determined by chemical and diffusion parameters of components. (auth)

43487 CORROSION BEHAVIOR OF TITANIUM–MOLYBDENUM–CHROMIUM ALLOYS. Tomashov, N. D.; Ruskol, Yu. S.; Filippov, A. F.; (and others). Zashch. Metal.; 6: No. 5, 499-504 (1970). (In Russian).

The corrosion and electrochemical behavior of Ti alloys with 5 and 10% Mo, additionally alloyed with 1, 5, and 10% Cr, were studied in 40% H_2SO_4 at various temperatures, using gravimetric, potentiostatic and x-ray methods. During active dissolution, the corrosion rate of single-phase alloys Ti–5Mo–10Cr and Ti–10Mo–10Cr was considerably less than that of two-phase $\alpha + \beta$-alloys, both two-component alloys Ti–5Mo and Ti–10Mo and alloys containing less than 10% Cr. Addition of Cr reduces the susceptibility of alloys to transpassivation caused by the presence of Mo, but at E > 1.2 V, the corrosion rate of Ti–Mo–Cr alloys begins to increase due to the susceptibility of Cr to transpassivation. During dissolution in the active state of two-phase $\alpha + \beta$-alloys, the Mo-containing β-phase accumulates on the alloy surface. (Referativnyi Zh.)

43488 EFFECTS OF PRODUCT CONDENSATION ON REACTION-ENHANCED VAPORIZATION RATES AND ON THE TRANSITION FROM HOMOGENEOUS TO HETEROGENEOUS REACTION IN HIGH-TEMPERATURE METAL OXIDATION. Rosner, Daniel E. (Yale Univ., New Haven). Oxidation Metals; 4: No. 1, 1-25(May 1972).

In order to predict the vaporization rate of fume-forming condensed phases into reactant-rich gases it is necessary to account for the strong augmentation of vapor transport rates caused by bulk flow into the reaction-condensation zone. For this purpose a simple film theory is developed based on the idealization of a thin reaction-condensation ''front'' supplied by convection-diffusion processes normal to the surface, but with condensate removal by convection processes parallel to the vaporizing surface. The steady-state position or ''stand-off distance'' of the front and, hence, its effect on the observed mass transfer rate, are determined by the demands of local reactant stoichiometry at the front and species conservation throughout the two-part film, subject to the imposed vapor and oxidizer boundary concentrations. As applied to the problem of metal vaporization into reactive atmospheres, it was found that appreciable additional effects due to the condensation process are predicted in the limit of oxidizer-rich ambient gases. Combining this extended theory with the notion that there is an upper limit to the attainable magnitude of the vaporization rate enhancement at which the reaction regime must change from homogeneous to heterogeneous, leads to predicted critical (transition) oxidizer pressures valid even approaching the practically important limit of pure gaseous oxidizer. On the assumption that this transition will occur when the metal vaporization rate approaches that expected in a vacuum, illustrative calculations are presented for the metals Na, Mg, Ca, Al, Be, Fe, and Zr vaporizing into oxygen–inert gas mixtures, and conclusions are drawn concerning the impossibility of the vapor phase reaction mode at surface temperatures too far below the metal boiling (or sublimation) point. It was also found that the formalism can be extended to incorporate an alternative critical condition, perhaps more realistic under some experimental conditions, viz., oxygen penetration to the surface due to the finite thickness of the reaction zone. In either event, the model can be readily used to predict the homogeneous–heterogeneous transition locus and its dependence on the occurrence or nonoccurrence of product condensation, and physical, chemical, and aerodynamic parameters. (auth)

43489 ENVIRONMENTALLY INDUCED CRACKING OF ZIRCONIUM ALLOYS. Cox, B. (Chalk River Nuclear Labs., Ont.). Corrosion; 28: No. 6, 207-17(Jun 1972).

The fractography of zirconium and zirconium alloy specimens cracked in a number of aggressive environments has been studied. In methanol–iodine at room temperature, fractures were completely intergranular, but penetration occurred even in the absence of applied stresses. In methanol–hydrochloric acid solutions, although intergranular attack on unstressed specimens also occurred, the application of external stress caused a change to transgranular cracking. When exposed in air at 300 to 450°C (572 to 842°F) with coatings of chloride salts or immersed in a fused nitrate–iodide salt mixture, cracking of stressed specimens was predominantly transgranular, whereas in fused nitrate–chloride and nitrate–bromide salts at 300 to 450°C, the penetration was intergranular and occurred even on unstressed specimens with gross internal oxidation. Transgranular fractures can also be caused during dynamic bend tests in mercury and cesium. The transgranular fractures in methanol–hydrochloric acid; hot and fused salts; and liquid metals have characteristic differences. The mechanisms of both intergranular and transgranular failure are discussed. (auth)

43490 CRITICAL SPECIES IN THE TRANSGRANULAR STRESS CORROSION CRACKING OF TITANIUM ALLOYS IN AQUEOUS SOLUTIONS. Green, J. A. S.; Sedriks, A. J. (Inst. for Advanced Studies, Baltimore). Corrosion; 28: No. 6, 226-30(Jun 1972).

Stress corrosion tests using a Ti–8Al–1Mo–1V alloy in chloride containing solutions of dimethyl sulfoxide (DMSO), water, DMSO-water, and arsenic containing solutions, having been carried out to resolve the question as to whether chloride ions or hydrogen are the critical (i.e., failure inducing) species in the transgranular stress corrosion cracking (SCC) of high strength titanium alloys. No susceptibility could be detected in 3.5% LiCl–DMSO solutions using the notched cantilever beam test, and only very low crack velocities were observed in Instron tests in which the cross head motion was continued during the test. Additions of water to the 3.5% LiCl–DMSO solution in quantities exceeding 35%, increased the velocity of cracking in the Instron tests. The addition of arsenic, which is a hydrogen ion recombination poison, to aqueous chloride solutions, lowered K_{ISCC} in cantilever beam tests at applied potentials known to prevent the formation of arsine. These and other observations are discussed in terms of the current understanding of the transgranular cracking process, and it was concluded that in aqueous solutions the presence of hydrogen is responsible for the propagation of stress corrosion cracks. (auth)

43491 INFLUENCE OF NITROGEN AND WATER VAPOR ON THE OXIDATION OF THORIUM BETWEEN 400 AND 1000^{0}C. Holloway, Paul H. (Rensselaer Polytechnic Inst., Troy, N. Y.); Evans, Edward B. Oxidation Metals; 4: No. 1, 27-34(May 1972).

The reactions of thorium with air, oxygen, oxygen–nitrogen, and oxygen–water vapor atmospheres have been studied in the temperature range of 400 to 1000°C using thermogravimetric analysis and metallographic and x-ray diffraction examination. It was demonstrated that H_2O and N_2 as well as O_2 are involved in the reactions of thorium with air. Oxidation in pure oxygen followed a relatively slow rate. Faster rates and nonisothermal conditions were observed under certain conditions with mixed atmospheres. Above 600°C, N_2 caused accelerated oxidation and scale color changes. The effects of H_2O were similar but occurred below 600°C. The rate laws followed for reactions with air were complex combinations of cubic, parabolic, and linear laws. (auth)

Preparation and Fabrication

Refer also to abstracts 42902, 42941, 43195, 43217, and 43451.

43492 (BARC–592) PREPARATION OF CRYSTAL BAR ZIRCONIUM BY IODIDE PROCESS. Paul, C. M.; Sharma, B. P.; Shah, V. D.; Sundaram, C. V. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 19p. Dep. NTIS (U. S. Sales Only).

The design and operation of an all-metal system to produce kilogram quantities of crystal bar zirconium on a hot filament by the iodide process is described. Zirconium crystal bars (purity 99.9%+) up to 17 mm dia and 1050 mm length have been grown with this system and have given a button hardness of 60 to 80 VPN. At a filament temperature of 1200°C, a production rate of 0.20 g/h/cm length has been achieved. (auth)

43493 (RD/B/N–2218) ATTAINMENT OF LOW OXIDE LEVELS IN A STATIC SODIUM POOL. Pugh, A. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1972. 12p. Dep. NTIS (U. S. Sales Only).

Experimental work is presented on the rate of purification of sodium by mass transport of oxide along an induced concentration gradient. The gradient is induced by a linear temperature gradient along the sodium column. A theoretical treatment was given in a previous report and the apparatus used here is based on that theory. The method of analyzing sodium samples for their oxygen content is described. The results show that a high temperature static pool of sodium with a low level of oxide can be achieved in a practically useful time and the level maintained indefinitely—sodium temperature 520°C, oxygen level 8.5 ppM, duration 530 hours. The experimental rate of purification was much higher than predicted by the purely diffusive mass transfer theory, possibly due to the presence of convective flows. (auth)

43494 FORMATION OF A NIOBIUM CARBIDE COATING ON STEELS. Minkevich, A. N.; Serebrennikova, V. S.; Kuznetsov, G. D. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 11, 155-7 (1971). (In Russian).

The processes underlying the formation of an NbC layer on the surface of two industrially-important types of C steel on treating these in a mixture of Nb_2Cl_5 and Ar, with or without propane, at 900 to 1100°C were studied. The formation of the NbC was initially due to the diffusion of C from the base into the growing layer, with the active participation of the Fe. The rate of growth depended on the precise nature of the steel. The introduction of propane into the mixture prevented the formation of a decarburized layer under the NbC. The coatings so obtained were very dense and hard, with a good adhesion to the base. (Metals Abstr.)

43495 HEAT FLOW PARAMETERS AFFECTING THE UNIDIRECTIONAL SOLIDIFICATION OF PURE METALS. Prates, M. (Aerospace Technical Center., Sao Jose dos Campos, Brazil); Fissolo, J.; Biloni, H. Met. Trans.; 3: No. 6, 1419-25(Jun 1972).

Unidirectional solidification of pure metals has been studied as a function of liquid superheat, heat transfer coefficient of the metal/mold interface (h_i), and mold material. Experimental results show that the position of the solid/liquid interface (X) varies with time (t) following the relationship $X(t) = A \cdot t^{½} - B$, where, for a fixed metal, B is a constant only dependent on the superheat through a parabolic law and A is another constant that is independent of the superheat but dependent on the mold heat sink capacity, i.e., mold material and coefficient h_i. At the same time, it has been calculated that the constant A varies with h_i through an error-function type law tending asymptotically to Lyubov's exact analytic solution. (auth)

43496 LITHIUM-LEAD COLLIMATOR FABRICATION FOR RADIOISOTOPIC SOURCE NEUTRON RADIOGRAPHY. Brauer, Charles; Draper, E. Linn Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 15: No. 1, 142-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43497 WELDING OF A MOLYBDENUM TEST STAND FOR CHEMICAL PROCESSING. Moorhead, A. J.; Slaughter, G. M. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 227-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43498 WELDABILITY OF NIOBIUM-STABILIZED 2¼ Cr–1 Mo STEEL. Canonico, D. A.; Slaughter, G. M. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 228 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43499 REMOVAL OF CARBON FROM MOLYBDENUM. Kolot, V. Ya.; Tatus, V. I.; Vodolazhchenko, V. V.; (and others) (Physical-Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 111-13(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 144-6(Jan 1972).

Removal of small amounts of carbon from molybdenum in heating in a hydrogen atmosphere (with a hydrogen pressure of 5×10^{-6} torr) is studied by the secondary ion-ion emission method. Decarbonization occurs as a result of diffusion of carbon atoms to the surface of the molybdenum from the interior, subsequent surface reaction of the carbon with hydrogen, which leads to formation of methane molecules at the surface, and desorption of the methane into the gaseous phase. The time required to purify molybdenum of carbon depends on the temperature of the former. The heating time is 4 h at 1800°K and increases to 10 h at 1300°K. Comparison of the decarbonization of molybdenum in heating in hydrogen and in oxygen, taking account of certain drawbacks in working with oxygen, indicates that heating in hydrogen is to be preferred. (auth)

43500 PROBLEM OF THE STRENGTH OF NICKEL REINFORCED WITH TUNGSTEN FIBERS. Golovin, V. N.; Rybal'chenko, N. D.; Somov, A. I.; Tron, A. S. Probl. Prochnosti; No. 11, 91-4(1971). (In Russian).

Vacuum rolling is used to produce a nickel-tungsten fiber sheet composition material with a volumetric fiber content of from 4 to 16%. The specifics of deformation of fibers are studied in the process of combined rolling with the plastic matrix. Mechanical properties of the composition are studied in extension, along with the nature of its rupture at 20 to 800°C. (JPRS)

43501 ALTERATIONS OF Δ-FERRITE AS A CONSEQUENCE OF ANNEALING IN PLATE-WELDING OF AUSTENITIC STAINLESS STEEL ON MATERIALS FOR NUCLEAR PURPOSES. Di Teodore, L. (Istituto di Richerche Breda, Milan); Dumini, W.; De Altamer, A. Met. Ital.; 64: No. 4, 117-22(Apr 1972). (In Italian).

Research has been conducted on the alteration forms of the Δ-ferrite in the plate-welding of austenitic stainless steel as a consequence of annealing treatments applied to industrial cycles. The research was carried out on the basis of metallographic tests, x-ray diffractometric analysis, and microanalysis obtained by using electronic microsound. (auth)

43502 METHOD OF PRODUCING A METALLIC JOINT BETWEEN Mg OR Mg ALLOYS AND HIGH MELTING POINT METALS OR ALLOYS. Pegoud, Joseph (to Societe Industrielle de Combustible Nucleaire). French Patent 2,076,383. 20 Sep 1971. Filed 13 Jan 1970. (In French).

A method of forming a metallic joint between a piece of Mg or Mg alloy and a high melting point metal (Fe, Mo, Nb, Ta, Ti, U, or Zr) or an alloy based upon such a metal is presented. A joining material containing a metal that forms a eutectic with Mg (such as Ni) is interposed between the two metallic pieces to be joined. The temperature, pressure, and heating time at the moment when the pieces are assembled are controlled in such a way that the eutectic undergoes limited diffusion in the liquid phase into the Mg or the Mg alloy and also in the high melting point metal or alloy. (France)

43503 IMPROVEMENTS TO JOINTS IN TUBES CARRYING LIQUID METALS. Carbonnel, Henri; Descleve, Pierre (to Groupement Atomique Alsacienne Atlantique). French Patent 2,075,855. 15 Oct 1971. Filed 29 Dec 1969.

A joint for connecting tubes carrying liquid metals is described. Two annular rings are compressed between the flanges of the tubes to be joined. These annular rings are made of ceramic fiber and have cross sections identical with those of the flanges. The system is provided with a toroidal part situated between the annular rings, which facilitates the tightening of the joint; a cooling device is also provided. A characteristic of this joint is that it incorporates a thermal insulation between the inside of the flange, in contact with the liquid metal, and the outside of the flange, in contact with the atmosphere, such that the temperature of the outside of each flange remains very much less than the melting temperature of the liquid metal inside the tubes. (France)

43504 EFFECT OF OCCLUDED GAS IN SINTERED CERAMICS. Amato, I. Atti Notiz. (Publ. in Met. Ital.); 26: No. 3, 87-96(Mar 1971). (In Italian).

Mechanisms which operate during the sintering of pressed powders are discussed; the theories behind them are based on the assumption that the surface tension is the driving force for the sintering process. Mathematical treatment of pore elimination is presented, and related experimental observations of the distribution of open pores in a UO_2 pellet during various stages of sintering are summarized. In further experiments with UO_2 pellet sintering, the coarse pore and fine pore fractions (percent of compact volume) were studied as functions of the percent of the theoretical density of the pellet under study. The limiting density attained in a pressed compact subjected to sintering was shown to still contain pores filled with gas. This non-diffusing gas is further determined by the equilibrium conditions between the pressure of the occluded gas in the residual pores and the pressure generated by the surface tension due to the curved surface of the pores. (K.S.W.)

43505 BRAZING TECHNOLOGY AS APPLIED TO THE CONSTRUCTION OF NUCLEAR COMPONENTS. Amato, I. (Fiat Nucleare, Turin). Atti Notiz. (Publ. in Met. Ital.); 25: No. 10, 339-43(Oct 1970). (In Italian).

The relative advantages of brazed joints are reviewed. Brazing of metals in an atmosphere of commercial hydrogen gas with preliminary purification of a Pb–Ag diffuser is described. Twenty curves for metal-oxide equilibria in H_2 are given with the two variables being the dew point (partial pressure of H_2O) and temperature (25 to 3,500°F). The curves include WO_2, MoO_2, NbO_2, Ta_2O_5, UO_2, BeO, and ThO_2. The importance of prior removal of any oxide coat, and the relation of the latter to the dew point was clarified. Differential cooling rates must be allowed for after brazing to avoid distortion. Brazing under vacuum (10^{-4} torr) is still in an experimental phase. A long cooling time is required, thus a coolant gas is frequently introduced during the cooling cycle. Induction brazing is accomplished by inducing electric currents in the parts to be brazed, and in the case of the assembly of a probe for measuring neutron fluxes, employs a 15 kW generator operating at a frequency of 300 kHz. (K.S.W.)

43506 HYPOTHESIS OF EVOLUTION OF TRADITIONAL STEELMAKING WITH THE USE OF NUCLEAR ENERGY. Antonioli, A. (Centro Sperimentale Metallurgica, Rome). Met. Ital.; 63: No. 2, 49-60(Feb 1971). (In Italian).

The history of iron and steelmaking shows a continuous trend toward a lower consumption of energy-producing raw materials and toward the use of less expensive and more readily available energy sources. This line of development has led to recent studies on the injection of reformed gas into the blast furnace stack. With the development of nuclear reactors producing very cheap power i.e., high-temperature gas reactors able to yield equally cheap heat, a new means is available to the steelmaker for the reduction of the consumption both of coke and hydrocarbons. Some operating schemes are proposed based on traditional steelmaking methods (hot metal blowing) which have in common the substitution of heat-producing coke by electric power; the difference is to be found in the quantity of reformed hydrocarbons injected in order to enhance the indirect reduction reaction thus lowering the coke consumption, in the use of nuclear heat in order to reduce the cost of injection, or in the recycling of the top gases in order to lower the hydrocarbon consumption. Using simplified models the energy consumption in various schemes was evaluated; the hypotheses regarding the future cost evolution of different energy sources, which will determine the cost competitiveness of the various processes, are highlighted. (auth)

43507 POROUS SINTERED TITANIUM-BASE ALLOYS. Arensburger, D. S.; Kopylova, V. P.; Perepelkin, A. V. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 38-41(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 48-52(Jan 1972).

Powder metallurigical Ti–20% Mo–5% Cr–0.2% Pd alloys sintered at 1400°C exhibit high resistance to corrosion by hot and concentrated hydrochloric and nitric acid solutions and may be employed for the production of permeable materials. To obtain coarse complex alloy powders, it is necessary to subject sintered specimens of multicomponent titanium alloys to hydrogenation and subsequent dehydrogenation. (auth)

43508 PREPARATION OF HIGH-PURITY NIOBIUM–ZIRCONIUM ALLOYS STRIPS. Olzi, E.; Ortali, P. (CNR, Milan). Met. Ital.; 64: No. 5, 243-8(May 1972). (In Italian).

A manufacturing method for high-purity niobium–zirconium alloys strips has been developed for application in the superconductors field. The starting material (sponge) was first purified by high-vacuum melting, swaged and then vacuum re-melted in order to obtain homogeneous ingots, taking into consideration the reactivity of such materials with the gases of the residual atmosphere. The ingots were heat-treated for recrystallization and cold worked into wires and finally strips having the required properties. The items thus obtained were then chemically and physically characterized. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 42923, 43200, 43411, 44164, 44567, 44569, 44576, 44577, 44587, 44594, 44656, and 44696.

43509 (COO-1198-909) STUDY OF LOW TEMPERATURE MICROCREEP IN NIOBIUM SINGLE CRYSTALS. Bluem, Melvin Francis (Illinois Univ., Urbana). Jun 1972. Contract AT(11-1)-1198. 135p. Dep. NTIS.

Thesis.

A study of the mechanism or mechanisms controlling thermally activated slip deformation in niobium single crystals was conducted by a creep deformation experiment in the temperature range from 5°K to 300°K. The main emphasis was placed on a determination of the activation parameters. In addition to activation volume measurements, the activation enthalpy was determined at each temperature by temperature cycling. This avoids the less direct method, which necessitates employing the temperature derivative of yield stress used frequently in other investigations. The tests were performed on ultra high vacuum annealed specimens and specimens with a controlled amount of interstitial atoms added after annealing to study the impurity effects. Room temperature prestrain of 1% or less was used to study the effects of dislocation structure on the activation parameters. The resulting data are compared with those in the literature for activation parameters obtained in constant strain rate experiments at much larger strains. (J.R.D.)

43510 (EUR-4757) PROPERTIES OF REFRACTORY METALS. Ferrero, G. L. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). May 1972. 42p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 60,-.

Physical, chemical, thermal, and mechanical properties together with temperature-dependent details where applicable, of refractory metals which can be used for the construction of high-temperature irradiation rigs are reported. The data are arranged to provide easy comparisons in the selection of the metals. (auth)

43511 (EUR-4819) MEASUREMENT OF THE CRITICAL CRACK OPENING DISPLACEMENT (C.O.D.) OF A Zr–2.5 PERCENT Nb ALLOY ON TRANSVERSE SINGLE-EDGED NOTCH SAMPLES. Henry, B. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1972. 50p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 70,-.

The critical crack opening displacement (COD) of Zr–2.5% Nb pressure tube material was measured on several batches or transverse single edge notched (S.E.N.) samples, using different tensile machines, strain rates and COD measurement methods. A high degree of scattering was found on the critical COD values relative to the as-fabricated samples (130 to 300 μ). As these values are consistent with those predicted from the critical load, taking into account a plasticity correction, this scattering is considered as inherent to the measured parameter, and due to the influence of the strain rate as well as the heterogeneity of the material itself. Annealing of the samples at 450 and 475°C during 10 hours increased the COD at fracture and anticipated the intervention of stable crack growth. The results are presented and discussed in the view of stressing the influence of some typical parameters on the values and the significance of the critical COD. (auth)

43512 (HSSTP-TR-19) EFFECTS OF STRAIN GRADIENTS ON THE GROSS STRAIN CRACK TOLERANCE OF A533-B STEEL. Randall, P. N. (TRW Systems Group, Redondo Beach, Calif.). 15 Jun 1972. Subcontract 3134. 45p. Dep. NTIS.

For Oak Ridge National Lab., Tenn.

The effects of strain gradients on gross strain crack tolerance were measured. Strain gradients were introduced by loading in bending or by placing the crack in the bottom of a groove. Proper characterization of all the strain gradients tested required consideration of the strain values at two locations. The first was a gross strain in the net section normal to the crack plane at mid-crack depth, the approximate location along the crack border where fracture originated. Critical values of this strain were defined as the gross strain crack tolerance (GSCT). The second strain value, by which the effect of strain gradients on GSCT was best represented, was the gross strain on the back face in the gross section above and below the crack. At a given temperature within the transition region, GSCT increased in direct proportion to the degree of tensile strain on the back face of the gross section. Tests in bending, which put the neutral axis between the crack tip and the back face, produced the lowest value of GSCT, while those in which the crack propagated into regions of increasing tensile strain yielded the highest GSCT. These effects were related to the influence of back face strain on the development of the plastic zone and consequent relief of constraint. The results suggest a cautionary note regarding a strain energy approach where the total energy absorbed within a sizeable gage length is measured. Compressive strain on the back face of a beam contributes to the total energy just as tensile strain at the back face does in a tensile test, but the results showed that they have opposite effects on gross strain crack tolerance. (P.C.H.)

43513 (IS-T-508) REACTION OF Fe-Ni-Cr ALLOYS WITH OXYGEN-CONTAINING SODIUM. Wu, Paul Chu-Sheng (Ames Lab., Iowa). May 1972. Contract W-7405-eng-82. 89p. Dep. NTIS.

Thesis.

Metallographic, electron microprobe, and x-ray diffraction analyses were employed to identify the reaction products formed in the reaction band between oxygen-containing sodium and Inconel 600 (Ni-76.13, Cr-15.39, Fe-7.71, Si-0.32, Mn-0.21, C-0.04 wt.%). Hexagonal sodium chromite, $NaCrO_2$, is the principal product formed at temperatures of 650, 750, and 850°C. The reaction bands showed evidence of grain boundary penetration and internal oxidation. Similar analyses showed that minor surface reaction and grain boundary penetration occurred at the interface of pure iron and pure nickel in contact with oxygen-saturated sodium at 850°C. The nickel interface showed the least evidence of attack. But there was no evidence of adherent reaction products at the surface or in the grain boundaries. Electromotive force measurements on galvanic cells involving single crystal CaF_2 and yttria doped thoria as solid electrolytes were made to obtain the standard free energy of formation of the compounds $NaCrO_2$, Na_2FeO_2, $(Na_2O)_2 \cdot FeO$, and Na_2NiO_2 in the temperature range of 400 to 600°C. The data showed that $NaCrO_2$ is the most stable, and it will be formed in a stainless steel sodium test loop with oxygen concentration greater than about 50 ppM. The compound Na_2FeO_2 was stable in oxygen-saturated sodium above about 600°C and the compound $(Na_2O)_2 \cdot FeO$ became stable at about 800°C. Nickel double oxide Na_2NiO_2 was not stable in oxygen-saturated sodium at temperatures up to 850°C. (auth)

43514 (IS-T-509) SINGLE CRYSTALLINE ELASTIC CONSTANTS OF C15-TYPE MAl_2 INTERMETALLIC COMPOUNDS. Schiltz, Raymond John Jr. (Ames Lab., Iowa). May 1972. Contract W-7405-eng-82. 52p. Dep. NTIS.

Thesis.

The single crystalline elastic constants of the cubic Laves phase compounds $CaAl_2$, YAl_2, $LaAl_2$, and $GdAl_2$ have been determined over the temperature range 4.2 to 300°K. The elastic constants generally exhibit a monotonic decrease with increasing temperature while the elastic anisotropy ratio is essentially temperature independent. Values for the Debye temperatures and bulk moduli for these phases appear to be determined primarily by the aluminum sublattice. This observation is consistent with the atomic contacts which are constrained to occur because of the atomic radius ratios within the geometry of the crystal structure. The phase $LaAl_2$ appears to be atypical. Extensive work in the literature showed two separate ranges of electron-to-atom ratios for which the cubic Laves phases are stable. The present elasticity data when combined with previously available data showed that the elastic anisotropy ratios, Poisson's ratios, and electronic bulk moduli have distinctively different values within the two groups of electron-to-atomic ratios. It is still equivocal that this grouping of the elastic parameters is solely a Fermi surface-Brillouin zone boundary interaction. An alternate possibility is a d-level bonding contribution in one of the groups but not in the other. (80 references). (auth)

43515 (IS-T-521) EFFECT OF ZIRCONIUM ON THE STRENGTH OF THORIUM. Zabel II, Daniel Carl (Ames Lab., Iowa). May 1972). Contract W-7405-eng-82. 43p. Dep. NTIS.

Thesis.

The flow stress of thorium–zirconium alloys containing up to 12 atomic percent zirconium was studied over a range of temperatures and strain rates. It was found that the flow stress could be broken into a thermally activated and an athermal component. The thermally activated component was nearly the same in the base metal and the zirconium alloys. The major effect of zirconium was a considerable increase in the athermal component. The magnitude of this increase was directly proportional to the zirconium content. Zirconium also retarded the recovery and recrystallization processes. (auth)

43516 (N-72-15521) CYCLIC CREEP AND FATIGUE OF TD-NiCr (THORIA-DISPERSION-STRENGTHENED NICKEL-CHROMIUM) TD-Ni, AND NiCr SHEET AT 1200 C. Hirschberg, Marvin H.; Spera, David A.; Klima, Stanley J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Feb 1972. 29p. (NASA-TN-D-6649; E-6601). NTIS.

The resistance of thin TD-NiCr sheet to cyclic deformation was compared with that of TD-Ni and a conventional nickel–chromium alloy. Strains were determined by a calibration technique which combines room-temperature strain gage and deflection measurements with high-temperature deflection measurements. Analyses of the cyclic tests using measured tensile and creep-rupture data indicated that the TD-NiCr and NiCr alloy specimens failed by a cyclic creep mechanism. The TD-Ni specimens, on the other hand, failed by a fatigue mechanism. (auth) (STAR)

43517 (RD/B/N-2143) METHOD FOR THE DETERMINATION OF THE CRITICAL STRESS INTENSITY FACTOR NECESSARY FOR FATIGUE CRACK PROPAGATION. Priddle, E. K.; Jerram, K. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1972. 17p. Dep. NTIS (U. S. Sales Only).

The importance of the determination of the critical stress intensity for crack propagation, particularly in relation to reactor components, is discussed. Existing experimental methods are reviewed and attention is drawn to the lack of published data. A new method is described which was developed for use with an Amsler Vibrophore fatigue machine. Standard compact tension type test specimens are used, and the cyclic stress intensity factor automatically reduces as the crack propagates. The critical value of stress intensity is determined when propagation ceases. It was concluded that the technique is economical in terms of material and operator effort, and shows practical advantages over the alternative available methods. Recent work using this technique is reported for EN3A, a structural mild steel. (auth)

43518 MECHANICAL PROPERTIES OF ALLOYS OF TITANIUM WITH VANADIUM AND ALUMINUM AS FUNCTIONS OF OXYGEN CONTENT. Maksimov, Yu. A.; Kornilov, I. I.; Voynitskii, A. G.; Blashchuk, V. E.; Zagrebenyuk, S. D. Probl. Prochnosti; No. 11, 54-5(1971). (In Russian).

The possibilities for the production of alloys of titanium with high contents of oxygen, but retaining good mechanical properties were studied. It is shown that the addition of vanadium and aluminum produces oxygen-containing alloy with the required mechanical properties. (JPRS)

43519 EFFECT OF HEAT-RESISTANT COATINGS ON THE FATIGUE STRENGTH OF A HEAT-RESISTANT ALLOY. Ishchenko, I. I. Probl. Prochnosti; No. 10, 76-81(Oct 1971). (In Russian).

The effect of heat-resistant coatings (Al or Al–Zr alloy produced by either the powder spraying or the painting method) on the fatigue resistance of a heat-resistant Ni-base ZhS6K turbine-blade alloy was studied. The coatings initially exhibited no particular influence on the fatigue strength of the blade material; however, after preliminary holding for some period at the working temperature (950°C) the coated samples acquired an appreciable higher fatigue strength than the uncoated. The method of applying the coating made little difference to this effect. (Metals Abstr.)

43520 COMPRESSIVE STRENGTH OF REINFORCED COPPER-TUNGSTEN FIBER MATERIAL. Gorb, M. L.; Marek, B. A.; Teodorovich, O. K. Probl. Prochnosti; No. 11, 95-7 (1971). (In Russian).

Results are presented from comparative compressing testing of material based on copper, reinforced with high-strength tungsten fibers, and metal ceramic materials with the same volumetric content of components. It is demonstrated that the compressive strength of the reinforced material at room temperature is double the strength of the metal ceramic material. The mechanism of rupture of the reinforced material is described schematically. (JPRS)

43521 LANTHANIDE CONTRACTION AND THE PROPERTIES OF COMPOUNDS OF THE RARE EARTHS WITH NOBLE METALS. Khamidov, O. Kh.; Savitskii, E. M. (Inst. of

Chemistry, Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR; 14: No. 7, 33-7(1971). (In Russian).

A study was made of the manifestation of the lanthanide contraction (resulting from the increasingly poor screening properties of the 4f orbital from La to Lu and an accompanying shrinkage of the atomic radius) in the properties of alloys AB_2 of the rare earth metals (A) with the noble metals (B). Here B stands for Ru, Rh, Os, Ir, or Pt. For each compound AB_2 the lattice parameters, microhardness, and density were taken from the literature for comparison. The Ce subgroup forms $MgCu_2$-type compounds with Ru; beginning with Gd, $MgZn_2$-type is stabilized. The effect of the lanthanide contraction is discussed. 13 references. (K.S.W.)

43522 FEATURES OF AGING OF LOW-ALLOY MOLYBDENUM-BASED ALLOYS. Zueva, I. B.; Mezhennyi, Yu. O.; Skakov, Yu. A. Steel USSR (Engl. Transl.); 1: No. 7, 575-6(Jul 1971).

The change in the lattice parameter of the solid solution of solutes in molybdenum throughout the depth of the specimen in relation to annealing temperatures was investigated by x-ray diffraction. The decomposition processes with the precipitation of the carbide phases ZrC and Mo_2C occur only in the surface layers of the material and inhibit the development of recrystallization in them. (auth)

43523 TITANIUM-RICH END OF THE Ti–Cd PHASE DIAGRAM. Robertson, W. M. (North American Rockwell Science Center, Thousand Oaks, Calif.). Met. Trans.; 3: No. 6, 1443-5 (Jun 1972).

Ti–Cd alloys containing up to 30 at. % Cd have been prepared by diffusing cadmium from the vapor phase into pure titanium. Phase relations in these alloys have been explored by metallographic and x-ray techniques. Cadmium has quite a large solubility in the β phase of titanium at 1000°C. Addition of cadmium decreased the $\alpha \rightarrow \beta$ transformation temperature, forming a eutectoid at approximately 785°C. The solubility of cadmium in α titanium at the eutectoid temperature was approximately 6.5 at. %, decreasing with decreasing temperature. The phase in equilibrium with saturated α titanium was an intermetallic compound based on the composition Ti_2Cd. (auth)

43524 DETERMINATION OF THERMODYNAMIC INTERACTION PARAMETERS IN SOLID V–Ti–Cr ALLOYS USING THE MASS SPECTROMETER. Rolinski, Edmund J.; Hoch, Michael; Oblinger, Charles J. (Univ. of Cincinnati). Met. Trans.; 3: No. 6, 1413-18(Jun 1972).

The Knudsen effusion method was combined with a mass spectrometer sensing technique in order to determine thermodynamic interaction parameters of solid solution bcc alloys of V–Ti–Cr. A regular solution model was used to relate the vaporization data to ion current ratios obtained from the mass spectrometer. The temperature range of the vaporization experiments was 1400 to 1700°C, with alloy compositions ranging from 10 to 66 at. % of each of the three components in the ternary system. Modified interaction parameters were calculated by assuming only binary interactions (which is a good approximation at low third component concentrations). The results are: $\Omega_{TiV} = 1.8 \pm 0.2$ kcal/g-atom; $0 < N_{Cr} < 0.2$ for (T_{AV} = 1800°K), $\Omega_{TiCr} = 1.9 \pm 0.4$ kcal/g-atom; $0.1 < N_V < 0.4$ for (T_{AV} = 1750°K), and $\Omega_{VCr} = 3.1 \pm 0.7$ kcal/g-atom; $0.1 < N_{Ti} < 0.4$ for (T_{AV} = 1850°K). A temperature dependent form was an appropriate refinement of the results for the Ti–Cr system from 1500 to 1840°K. That expression is $\Omega = 28\,(1 - T/1840°K)$ kcal/g-atom. Overall, experimental results showed important, but not complete, agreement with estimates from phase diagrams and theoretically calculated values. (auth)

43525 LAVES AND μ PHASES IN THE Nb–Fe–Si AND Nb–Co–Si SYSTEMS. Singh, B. N.; Gupta, K. P. (Indian Inst. of Tech., Kanpur). Met. Trans.; 3: No. 6, 1427-31(Jun 1972).

The 1100°C isothermal sections indicate fairly large extensions of the C14 Laves phase and μ phase regions in the Nb–Fe–Si and Nb–Co–Si systems, respectively, and stabilization of a ternary C14 Laves phase in the latter ternary system. Both Laves phase and μ phase extensions were along constant niobium lines. The atomic size effect on the stabilization of Laves phase appeared to be small but it may be appreciable for the μ phase. (auth)

43526 CONSTITUTION OF THE SYSTEM Al–Ti–B WITH REFERENCE TO ALUMINUM-BASE ALLOYS. Maxwell, I.; Hellawell, A. (Oxford Univ.). Met. Trans.; 3: No. 6, 1487-93(Jun 1972).

Direct and differential thermal analyses have been used to determine the liquidus temperatures and isothermals in the aluminum-base corner of the Al–Ti–B system, and with microscopical information and electron microprobe analyses provide results on which is based a provisional phase diagram. The TiB_2 liquidus rises very steeply from the aluminum corner of the diagram and is bounded on either side by monovariant reactions which almost coincide with the binary Al–B and Al–Ti liquidus curves. If the Ti : B ratio exceeds 7 : 3 wt % (1 : 2 at. %), TiB_2 precipitates on cooling until there occurs a monovariant reaction involving Al_3Ti, while at lower Ti : B ratios there occurs a monovariant reaction which involves AlB_2. The grain refining action of ternary alloys is discussed with reference to the form of the phase diagram. (auth)

43527 LATTICE DIMENSIONS OF THE AB_2 LAVES PHASES. Edwards, A. R. (Aeronautical Research Labs., Melbourne). Met. Trans.; 3: No. 6, 1365-72(Jun 1972).

A combined geometric/chemical model is proposed to account for the observed lattice dimensions of the cubic AB_2 Laves phases. These compounds were treated as a hybrid structure between the simple metallic bcc and fcc structures, the interatomic spacings depending on the atomic diameters of the pure A and B metals and on the difference in their electronegativities. The model was successful enough to indicate that the electronegativity concept could well find wider quantitative applications in alloy chemistry than it has in the past. The treatment used also led to qualitative explanations for the relative frequency of occurrence of cubic and hexagonal Laves phases, the incidence of allotropy in these compounds, the nonappearance of Laves phases in certain apparently favorable alloy systems, and the minimum A-metal content found in phases showing a range of homogeneity. (auth)

43528 EFFECT OF COMPOSITION ON THE PROPERTIES OF STRAIN-TRANSFORMABLE β TITANIUM ALLOYS. Williams, D. N.; Wood, R. A.; Bartlett, E. S. (Battelle Columbus Labs., Ohio). Met. Trans.; 3: No. 6, 1529-36(Jun 1972).

A number of metastable β titanium alloys were examined to determine the effects of composition on strain-transformation behavior and precipitation hardening response. Maximum ductility as solution heat treated was observed in alloys slightly richer in alloy content than the minimum alloy content required to retain an all-β microstructure on quenching. Such materials transformed to a martensitic structure upon straining and, as a result of strain transformation, developed room temperature ductility exceeding that found in unalloyed titanium. Uniform elongation of 35 to 45% was observed in a number of compositions of this type containing major additions of Mo, V, Cr, or Mn. Auxiliary alloy additions of Sn, Al, or Zr, or ternary alloying with molybdenum were necessary to prevent ω embrittlement during quenching in alloys containing V, Cr, or Mn. Alloying with Fe, Cu, Co, or Ni resulted in low ductility as solution heat treated, but it is probable that optimum amounts of these additions were not studied in this investigation. Oxygen above about 1200 ppM also had a detrimental effect on ductility. All alloys studied showed precipitation hardening when heat treated in the 800 to 1100°F range. Tensile strengths of 170 to 190 ksi were readily attainable in most alloy systems. Ductility as precipitation hardened appeared to be higher in alloys containing at least 6% Mo or V than in other alloys studied. (auth)

43529 STUDY OF A SPLAT COOLED Cu–Zr-NONCRYSTALLINE PHASE. Revcolevschi, A.; Grant, N. J. (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 3: No. 6, 1545-8(Jun 1972).

By rapid quenching from the melt, using the splat forming gun technique, a noncrystalline phase has been obtained in a Cu–Zr alloy containing 60 at. % Cu. Upon heating, rapid crystallization of the samples takes place at 477°C with a heat release of about 700 cal per mole. The variation of the electrical resistivity of the samples with temperature confirmed the transformation. Very high resolution electron microscopy studies of the structural changes of the samples, at 3×10^6 magnification, upon heating are presented and show the gradual crystallization of the amorphous structure. (auth)

43530 PRESSURE-COMPOSITION-TEMPERATURE STUDY OF Zr–Nb–H SYSTEM. Sinha, V. K.; Singh, K. P. (Indian Inst. of Tech., Kanpur). Met. Trans.; 3: No. 6, 1581-5(Jun 1972).

The solubility of hydrogen was determined in the (Zr + 5 wt % Nb) – H_2, (Zr + 10 wt % Nb) – H_2, and (Zr + 20 wt % Nb) – H_2 systems as a function of composition, temperature (700 to 950°C) and hydrogen equilibrium pressure (0.5 to 760 mm Hg). The position of boundaries β-($\beta + \delta$) and ($\beta + \delta$)-δ were determined in each of the above three systems. Niobium significantly reduced the solubility of hydrogen in the β and δ phases and increased the equilibrium hydrogen pressure for any fixed concentration. The equilibrium pressure-temperature relations in the two phase region ($\beta + \delta$) were derived and the heat of formation of δ-hydride from saturated β-Zr, $\Delta H_{\beta \rightarrow \delta}$ were determined. The value of $-\Delta H_{\beta \rightarrow \delta}$ increased up to about 5 wt % Nb after which the effect of niobium seemed to be insignificant. The maximum hydrogen pick-up of zirconium at room temperature decreased with increasing niobium content of the alloy. (auth)

43531 FORMATION OF THE ω PHASE IN Ti–Nb ALLOYS. Balcerzak, A. T.; Sass, S. L. (Cornell Univ., Ithaca, N. Y.). Met. Trans.; 3: No. 6, 1601-5(Jun 1972).

The as-quenched and the aged form of the ω phase in Ti–Nb alloys were examined using high-resolution dark field electron microscopy and diffraction. The as-quenched ω morphology was found to be based upon ⟨111⟩ rows of equiaxed particles which are 12 to 20 Å in diameter and spaced 20 to 22 Å apart. After short aging times the ⟨111⟩ row length increased, and eventually the isolated rows were replaced by clusters of rows. With continued aging the clusters increased in size and evolved into an ellipsoidal shape. The as-quenched Ti-18 at. % Nb alloy exhibited sharp ω reflections and {111} planes of diffuse intensity in reciprocal space. As the niobium content of the alloy increased the ω reflections broadened, and in alloys containing 34 at. % Nb or more, the 0001 and 0002 ω reflections were shifted toward each other along an ⟨0001⟩ direction. The forbidden $10\bar{1}0$ and $20\bar{2}0$ ω reflections were found to be real in aged alloys, indicating that the aged form of the ω phase is ordered. (auth)

43532 SHORT-RANGE ORDER IN SILVER-RICH Ag–Cd SOLID SOLUTIONS. Waldman, J.; Bever, M. B. (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 3: No. 6, 1607-11(Jun 1972).

The short-range order in Ag–Cd alloys containing 5 to 38 at. % Cd was investigated by liquid metal solution calorimetry and electrical resistivity measurements. The results indicated that the degree of short-range order in slowly cooled specimens was equivalent to equilibrium short-range order at approximately 450 to 500°K. Specimens quenched from various temperatures showed the effects of heat treatment on the degree of short-range order. The energy effects associated with short-range order in the composition range 16 to 38 at. % Cd were approximately 60 to 90 cal per g-atom. It was concluded from the results that the resistivity in Ag–Cd alloys decreased with increasing degree of short-range order. (auth)

43533 ROLLING TEXTURE OF Pu–Ga ALLOYS AS A FUNCTION OF TEMPERATURE. Moment, Roger L. (Dow Chemical Co., Golden, Colo.). Met. Trans.; 3: No. 6, 1639-44(Jun 1972).

The rolling textures of a series of Pu–Ga fcc δ stabilized alloys are reported as a function of both the percent reduction and the temperature of rolling. Though twinning in the cast and homogenized alloys increased with the gallium concentration, no change in rolling texture was observed as a function of gallium for specimens rolled at room temperature. Rolling of these alloys at temperatures down to −196°C caused a texture transition similar to that observed in copper rolled at low temperatures. The stacking fault energy was estimated to be 30 erg per cm^2. For the Pu–3.4 at. % Ga alloy, this texture transition occurred at a higher temperature than in the other two alloys, and it is known that in this case some α phase was formed during rolling. (auth)

43534 COMMENT ON THE STRENGTH DIFFERENTIAL (SD) EFFECT IN TD NICKEL. Wilcox, B. A. (Battelle Memorial Inst., Columbus, Ohio); Clauer, A. H.; Luetjering, G. Met. Trans.; 3: No. 6, 1666-78(Jun 1972).

Evidence is given for a suspected lack of reproducibility of the strength differential (SD) effect in TD nickel (Ni–2% ThO_2) bar in reference to a previously published article by Olsen and Ansell (Trans. ASM, 62: 711(1969)) in which it was stated that variations might be expected in the SD effect in samples from different heats of a given alloy or from samples of the same heat that have been processed differently. The conclusion that the SD effect in TD nickel bar is not reproducible may be the result of different levels of impurities from one material to another, as suggested by Olsen and Ansell. (P.C.H.)

43535 CHARACTERIZATION OF THE DEFORMATION SUBSTRUCTURE OF AISI 316 STAINLESS STEEL AFTER HIGH STRAIN FATIGUE AT ELEVATED TEMPERATURES. Challenger, K. D.; Moteff, J. (Univ. of Cincinnati). Met. Trans.; 3: No. 6, 1675-8(Jun 1972).

Studies were made on the deformation substructure of AISI 316 stainless steel under fatigue at 430 to 816°C because the austenitic stainless steels are being considered as the fuel cladding material for the Liquid Metal Fast Breeder Reactors. It was found that the factors that affect the dislocation substructure are the slip character of the material, the deformation temperature, and the strain amplitude. The tendency for dislocation cell formation increased with increase in the stacking fault energy, temperature, and/or strain amplitude. (P.C.H.)

43536 THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF A TITANIUM–GADOLINIUM ALLOY. Shamashov, F. P.; Neimark, B. E.; Grebennikov, R. V.; Merkul'ev, A. N.; Posel'skii, V. B. High Temp. (USSR) (Engl. Transl.); 9: No. 6, 1208-10(Nov-Dec 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 6, 1308-10(Nov-Dec 1971).

Results of an investigation into the thermal conductivity, electrical resistivity, and Lorentz number of a binary alloy of titanium with 6.5% gadolinium and, for comparison, unalloyed titanium are presented. The ingots of the Ti–Gd alloy and of the unalloyed titanium were prepared in an arc furnace under an atmosphere of pure argon and using a nonconsumable electrode. The raw materials used consisted of iodide titanium of the first grade (99.9% pure) and metallic gadolinium of grade GM–O (99.8% pure). Results are presented graphically and discussed. (J.R.D.)

43537 NEW NONMAGNETIC ELINVAR-TYPE ALLOYS IN THE Mn–Cu–W SYSTEM. Masumoto, Hakaru; Sawaya, Shohachi; Kikuchi, Michio (Research Inst. of Electric and Magnetic Alloys, Sendai). J. Jap. Inst. Metals; 36: No. 5, 498-503(May 1972). (In Japanese).

Measurements of Young's modulus at −150 ~ 400°C and of rigidity modulus, thermal expansion, and hardness at room temperature have been carried out with Mn–Cu–W alloys subjected to cold working and a variety of heat treatments. In the Young's modulus vs temperature curves, the ternary alloys slow cooled after heating for 1 hr at 900°C showed anomalous changes which seem to be related to the antiferromagnetic ⇌ paramagnetic transformation. Young's modulus at room temperature did not show a large difference among the annealed, cold worked, or water quenched states, but this value increased with increasing manganese or tungsten contents. The temperature coefficient of Young's modulus shows a wide variation with the operation of annealing, water quenching, cold working, or reheating after water quenching or cold working; also with alloy composition. It is to be noted that the temperature coefficient of Young's modulus as a function of composition exhibits large positive maximum, thus showing the existence of the Elinvar property. The variation in rigidity modulus and its temperature coefficient with the heat treatment, cold reduction rate, and composition shows a close similarity to that in Young's modulus and its temperature coefficient. The hardness shows a very complicated change with the heat treatment, cold reduction rate, and composition; showing Vickers hardness of about 100 to 660. The corrosion resistance of Mn–Cu–W alloys is fairly good. (auth)

43538 NONMAGNETIC ELINVAR-TYPE ALLOYS IN THE Mn–Cu–Mo SYSTEM. Masumoto, Hakaru; Sawaya, Shohachi; Kikuchi, Michio (Research Inst. of Electric and Magnetic Alloys, Sendai). J. Jap. Inst. Metals; 36: No. 5, 492-7(May 1972). (In Japanese).

Measurements of Young's modulus at −150 ~ 400°C and of rigidity modulus, thermal expansion, and hardness at room temperature have been carried out with Mn–Cu–Mo alloys subjected to cold working and a variety of heat treatments. In the Young's modulus vs temperature curves, Mn–Cu–Mo alloys of about 30.10 ~ 60.22% Cu and 3.10 ~ 20.35% Mo slow cooled after heating for 1 hr at 900°C showed anomalous changes which seem to be related to the antiferromagnetic ⇌ paramagnetic transformation. Young's modulus at room temperature is generally higher in the annealed state than those in the cold worked or water quenched state and tends to increase with rise of reheating temperature after cold working or water quenching. The temperature coefficient of Young's modulus shows a wide variation with the operations of annealing, water quenching, cold working, and reheating after water quenching or cold working; also with alloy composition. It is to be noted that the temperature coefficient of Young's modulus as a function of composition exhibits a large positive maximum, thus showing the Elinvar property. The variation in rigidity modulus and its temperature coefficient with heat treatment, cold working, and composition shows a close similarity to that in Young's modulus and its temperature coefficient. The hardness of the alloys shows a very complicated change with composition, heat treatment, and cold working; showing Vickers hardness of about 130 to 700. The oxidation and corrosion resistances of Mn–Cu–Mo alloys are fairly good. (auth)

43539 STRUCTURAL CHARACTERISTICS OF MATERIALS. Finniston, H. M. (ed.). Elsevier Materials Science Series. New York; American Elsevier Publishing Company, Inc. (1971). 326p.

Six chapters are included on crystallography of materials; defect structures; mechanical twinning; martensitic structures; development of microstructure; and structural defects in nonstoichiometric compounds. (P.C.H.)

43540 STRUKTURA ZHIDKIKH METALLOV. (Structure of Liquid Metals). Khrushchev, B. I. Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1970). 112p.

Information is given on the structure of liquid metals and its application to the fusion process. The true metals which are discussed separately include Li, Na, K, Rb, Cs, Fe, Cu, Ni, Ag, and Au. The semi-metals include Ga, Ge, Sn, Sb, Mg, Al, In, Tl, Pb, Zn, Cd, and Hg. The nonmetals discussed are Se and Te. 124 references. (K.S.W.)

43541 COMPUTED RESPONSE OF SPHERICAL SHIELDING TO IMPACT LOADING. Hofmann, Ronald (Physics International Co., San Leandro, Calif.); Hancock, S. L.; Puthoff, R. L.; Wohl, M. Trans. Amer. Nucl. Soc.; 15: No. 1, 11-12(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43542 HAFNIUM–PLATINUM GROUP ALLOYS FOR RADIOISOTOPE THERMOELECTRIC GENERATOR APPLICATIONS. Ogren, J. R.; Appel, M.; Blumenthal, J. L.; Bramer, S. (TRW Systems Group, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 160(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43543 NEW PLATINUM–RHODIUM–TUNGSTEN ALLOYS FOR SPACE ISOTOPIC HEAT SOURCES. Inouye, H.; Liu, C. T.; Donnelly, R. G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 163-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43544 TRITIUM DIFFUSION IN ZIRCALOY-2 AND STAINLESS STEELS. Elleman, Thomas S.; Austin, John H.; Verghese, Kuruvilla (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 15: No. 1, 229-30(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43545 STUDY OF SHEAR STRESS OF SODIUM FOR DESIGN OF FREEZE-SEAL VALVES. Folkrod, J. R.; Misra, Balabhadra (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 236-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43546 COMPOUNDS AND PSEUDO-BINARY ALLOYS WITH THE $CuAl_2$(C16)-TYPE STRUCTURE. III. STABILITY AND COMPETITIVE STRUCTURES. Havinga, E. E.; Damsma, H. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 27: No. 3, 269-80(Jun 1972).

The $CuAl_2$-type structure was analyzed with the aid of near neighbor diagrams. It was concluded that this structure type for a compound AB_2 is stabilized by the presence of A–B as well as B–B contacts; although the A–B contacts may be strongly compressed and the average B–B contact rather loose, both influences are of comparable importance. The structure became unstable when the A–A or B–B contacts were very close. It follows that the stability of the $CuAl_2$-type structure is limited to radius ratios in the range $0.655 < r_A/r_B < 0.905 + 1.35\ (0.8165 - c/a)$. Area-of-stability plots of the borides BX_2 and the systems XM_2 with M a metal of group T^3, T^4, T^5, B^3 or B^4 of the Periodic Table, limited by the radius ratio condition $0.62 < r_X/r_M < 1.01$ and covering compounds in the concentration range $0.49 < x < 0.80$ (x is the concentration of M) are presented and discussed. (auth)

43547 SCAVENGING IN VANADIUM–TITANIUM ALLOYS. Hasson, D. F.; Arsenault, R. J. (Univ. of Maryland, College Park). Contract AT(40-1)-3612. J. Less-Common Metals; 27: No. 3, 417-18(Jun 1972).

An internal friction study was made on V–4 at. % Ti and V–20 at. % Ti alloys to determine if Ti acts as a scavenger of interstitials. The results showed no evidence of a Snoek peak at 2.52 at. % oxygen addition, which was greater than the solubility limit of oxygen in V. The oxygen Snoek peak appeared if the oxygen concentration was approximately equal to the Ti concentration. An explanation is given for previous results in which scavenging was reported. (P.C.H.)

43548 OBSERVATION OF FACE CENTRED CUBIC ERBIUM IN THIN FILMS AND ITS OXIDATION. Curzon, A. E.; Chlebek, H. G. (Simon Fraser Univ., Burnaby, B. C.). J. Less-Common Metals; 27: No. 3, 411-15(Jun 1972).

High energy electron diffraction studies of thin films of erbium formed by vapor deposition on carbon or on rock-salt-coated glass showed that the erbium has a face-centred-cubic structure with lattice parameter $a_0 = 5.09 \pm 0.05$ Å. Thicker films contained both the face-centred-cubic structure and also the normal hexagonal-close-packed structure of erbium in bulk. The thickest films studied had the normal bulk crystal structure. When the intensity of the electron beam was increased to its maximum value, the films oxidized to Er_2O_3. Such an intense beam caused rapid growth of the oxide crystals until holes appeared and the film eventually ruptured. Er_2O_3 was also observed when erbium was deposited on a substrate in a vacuum which had not been reduced by prior gettering with erbium vapor. (auth)

43549 SOME STRUCTURAL AND PHYSICAL PROPERTIES OF AS CAST MOLYBDENUM–RUTHENIUM ALLOYS. Flewitt, P. E. J. (Central Electricity Generating Board, Cockfosters, Eng.); Tate, A. J. J. Less-Common Metals; 27: No. 3, 339-52(Jun 1972).

The microstructure, hardness, and superconducting transition temperature of high purity, "as cast", molybdenum–ruthenium alloys (10–45% ruthenium) were studied. Optical and electron microscopy, together with selected area diffraction, allowed the morphology and crystallography of the three phases (α,β,σ) which occurred, singly or in combination, within this composition range to be analyzed. The intermetallic $\sigma(D8_b)$ compound precipitated from supersaturated α_{bcc} as Widmanstatten plates on $\{110\}_{bcc}$ habit planes with an orientation relationship $(001)_\sigma \parallel (011)_\alpha$ and $[110]_\sigma \parallel [\bar{1}1\bar{1}]_\alpha$. σ Precipitates as angular particles from the β_{hcp} phase with the orientation relationship $(001)_\sigma \parallel (0001)_\beta$ and $[1\bar{1}0]_\sigma \parallel [11\bar{2}0]_\beta$. The hardness of each alloy has been determined. Deformation occurred in the α_{bcc} phase by mainly $\{112\}\langle 11\bar{1}\rangle$ twinning and in the β_{hcp} phase by slip on both the basal and $\{11\bar{2}1\}$ planes. The intermetallic σ(~1000 VPN) showed little evidence of plastic deformation and only brittle fracture was observed. The σ phase had a superconducting transition temperature of ~9.2 K in the as-cast condition. (auth)

43550 ALLOYS OF THORIUM WITH CERTAIN TRANSITION METALS. V. THE $ThOs_2$–$ThIr_2$ PSEUDO-BINARY SYSTEM AND SOME ADDITIONAL RESULTS ON THE THORIUM–IRIDIUM SYSTEM. Thomson, J. R. (Imperial Coll. of Science and Tech., London). J. Less-Common Metals; 27: No. 3, 293-6 (Jun 1972).

The $ThOs_2$–$ThIr_2$ pseudobinary system was studied by x-ray and metallographic methods. The composition range of stability of the cubic C15-type phase was investigated and some information was obtained on the stability of other phases in the ternary system. Some new metallographic results on binary Th–Ir alloys containing 66–83% Ir are also reported. (auth)

43551 MELTING DIAGRAM FOR THE SYSTEM CHROMIUM–VANADIUM. Kocherzhinskii, Yu. A.; Shishkin, E. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 38, 93-4(1971). (In Russian).

Electrolytic Cr and V were used to prepare arc-melted alloys under argon, followed by 8-h annealing at 1,750°C. High-temperature differential thermal analysis yielded a complete melting diagram (solidus and liquidus), in which the minimum melting point was 1,810°C (66 weight % V). (tr-auth)

43552 COMPOSITION DIAGRAM FOR THE NIOBIUM–GALLIUM SYSTEM. Pan, V. M.; Latysheva, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 38, 95-100(1971). (In Russian).

The phase equilibrium diagram of the Nb–Ga system was constructed from data from differential thermal, microstructure, and x-ray analyses. A fairly wide region of solid solutions based on Nb was found (up to 20 at.% Ga at 1,750°C). Six compounds were demonstrated in the alloy system at room temperature: Nb_3Ga, Nb_5Ga_3, Nb_5Ga_4, Nb_4Ga_5, Nb_5Ga_{13}, and $NbGa_3$. At high temperatures still another compound, $NbGa_4$, exists in a narrow temperature interval. The temperature and character of formation of each compound were determined. The critical temperature of the superconducting transition of the compound Nb_3Ga, after annealing for 10 h at 800°C, was 16°K (at half-transition). (tr-auth)

43553 TECHNIQUES ASSOCIATED WITH THE USE OF SPECIAL METALS. II. ZIRCONIUM. Perez, M. (Societe Trefimetaux, Paris). Mater. Tech.; No. 1, 14-18(Jan 1971). (In French).

The physical, mechanical, corrosion resistance, and metallurgical properties of Zr and Zr alloys are briefly reviewed. The principal applications of Zr are in the nuclear industries, where it is used in structures or as cladding for fuel elements. Its remarkable corrosion resistance gives it applications in the chemical industry. The forming, machining, welding and brazing, surface treatments (cleaning coating), and thermal treatments carried out on this metal are discussed. Important considerations must be given to air contamination (N_2) precautions. (France)

43554 MOLECULAR BEAM INVESTIGATION OF ADSORPTION KINETICS ON BULK METAL TARGETS: NITROGEN ON TUNGSTEN. King, David A.; Wells, Michael G. (Univ. of East Anglia, Norwich, Eng.). Surface Sci.; 29: No. 2, 454-82(Feb 1972).

An ultrahigh-vacuum molecular-beam technique for the study of the kinetics of the interaction of reactive gases with well-defined metal surfaces is described. Well-collimated beams of nitrogen molecules, with an accurately measured intensity of 10^{12} to 10^{13}

molecules cm^{-2} sec^{-1} over a target area of ~4 × 10^{-2} cm^2, are obtained using a series of five chambers differentially pumped with a combination of high-speed diffusion pumps and strategically deposited titanium getter films. Out-of-beam leakage into the adsorption cell was <10^8 molecules sec^{-1}. A method is described for obtaining absolute values of sticking probabilities and surface coverages with a high degree of accuracy. For nitrogen on a polycrystalline tungsten foil, sticking probabilities and their coverage profiles were found to be independent of incident molecular beam angle, over a range of 60°, with an initial sticking probability, s_0, at 300°K of 0.61 ± 0.02. The sticking probability profile is monotonic over the range examined, and is theoretically described in terms of a modified form of Kisliuk's precursor state model, with self-consistent parameters. On a linear plot, the sticking probability extrapolates to zero at a coverage of 3.0(±0.5) × 10^{14} molecules cm^{-2}. On the W(111) plane, s_0 was found to be 0.08 ± 0.01, and the sticking probability falls linearly with increasing coverage, with a saturation coverage of 1.2(±0.2) × 10^{14} molecules cm^{-2}. It is argued that adsorption sites on the (111) plane are created by the presence of surface vacancies or randomly distributed W atoms on the perfect (111) surface. Within the limits of detection of the molecular beam technique no nitrogen adsorption could be detected on the (110) plane of tungsten, in agreement with previous work. (auth)

43555 ADSORPTION AND DISPLACEMENT PROCESSES ON W(111) INVOLVING CH_4, H_2, AND O_2. Madey, Theodore E. (National Bureau of Standards, Washington, D. C.). Surface Sci.; 29: No. 2, 571-89(Feb 1972).

Adsorption and displacement processes involving CH_4, H_2, and O_2 on the (111) surface of tungsten were examined using the thermal desorption method in conjunction with mass spectrometry and work function changes. Methane is physically adsorbed on W(111) at T ~ 125°K and desorbs with a binding energy of 8.0 kcal/mole. Neither adsorption nor decomposition of CH_4 is observed at 300°K on W(111). Hydrogen is chemisorbed on W(111); 4 atomic binding states having desorption energies ranging from 12 to 31 kcal/mole are observed. The influence of oxygen on the binding of both H_2 and CH_4 was examined. Oxygen specifically blocks the adsorption of certain hydrogen binding states; oxygen causes an increase in the CH_4 binding energy to ~10 kcal/mole. Coadsorption of hydrogen and CH_4 also exhibits site specificity. (auth)

43556 SATURATED STATE OF HYDROGEN ON TUNGSTEN AT ROOM TEMPERATURE. Sato, Mieko (Electrotechnical Lab., Tokyo). Surface Sci.; 29: No. 2, 667-8(Feb 1972).

A field-emission microscopic study was made of the result of heating of H_2 on W to 375°K. Certain regions ([001], and the region between the zone (011)−(110) and the zone (101)−(110)) become a little brighter after the heating, while other regions ((411) and neighboring planes, the surrounding of (211), and the region around (110)) become somewhat darker. (D.L.C.)

43557 STRUCTURE AND PROPERTIES OF ALNI ALLOYS WITH ADMIXTURES OF GALLIUM AND INDIUM. Afanas'ev, P. D. (Lvov Polytechnical Inst.). Metallofizika; No. 38, 77-83 (1971). (In Russian).

A series of alloys formed by adding Ga and In to the system Fe−Ni−Al with constant magnets were investigated; the optimum amounts of the added materials and the proper thermal treatment were sought. Microtesting established different solubilities for Ga and In, and indicated a dependence of structure, lattice constants, critical cooling rates, magnitude of optimum admixtures, and magnetic properties on the solubility. (tr-auth)

43558 CONTINUOUS OBSERVATION OF THE UNIDIRECTIONAL SOLIDIFICATION OF THE Bi–Cd EUTECTIC. Hamar, R.; Durand, F. (Ecole National Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). Mem. Sci. Rev. Met.; 69: No. 2, 143-9(Feb 1972). (In French).

The unidirectional solidification of Bi−Cd eutectic alloys was observed through a thin slice of quartz using a microscope and a stage having a temperature gradient. The liquid and the two solid phases are clearly distinguished in polarized light. The principal phase, Bi, grows with a faceted interface which is several microns in front of that of the Cd ribbons. The orientation of these ribbons depends upon the growth rate. In impure alloys, when V > 3 cm/h (G = 50°C/cm), two-dimensional eutectic cells are formed. X-ray analysis reveals that the crystallographic orientation of Bi varies with the growth rate, but does not affect the formation of cells. (France)

43559 COBALT ALLOYS WITH HIGH HOT-STRENGTH. Coutsouradis, Dimitri; Drapier, Jean-Marie; Davin, Armand (Center of Metallurgical Research, Liege). Z. Metallk.; 63: No. 6, 306-14(Jun 1972). (In German).

The low stacking-fault energy imparts a high strength to solid solutions of cobalt alloys. Eutectic reactions during solidification lead to carbide networks which increase the strength. An improvement in the mechanical properties of cobalt alloys at medium temperatures can be achieved by the precipitation of intermetallic compounds. Dispersion-hardened cobalt alloys and alloys with directional eutectics are already very promising, not only because of their mechanical properties, but also because of their resistance to corrosion at high temperatures. (auth)

43560 MECHANISM OF CATHODIC REDUCTION OF MOLYBDENUM JOINTLY WITH METALS OF THE IRON GROUP. Golubkov, L. A.; Yur'ev, B. P. (Leningrad Coke and Glass Plant). J. Appl. Chem. USSR (Engl. Transl.); 44: No. 11, 2491-4(Nov 1971).

Translated from Zh. Prikl. Khim.; 44: No. 11, 2419-24(Nov 1971).

A study of the cathodic polarization curves and charge oscillograms of cathodic polarization during electrodeposition of Fe−Ni−Mo alloy demonstrated that the cathodic polarization curves are of sigmoid form, owing to formation of a film of intermediate Mo compounds on the cathode. A possible mechanism is postulated for the process on the basis of oscillographic, polarization, microscopic, and other studies of joint reduction of Fe, Ni, and Mo from simple sulfate−molybdate electrolytes of moderate acidity. Deposition of Fe−Ni−Mo alloy is preceded by formation of a film of lower molybdenum compounds on the cathode. Fe and Ni ions then penetrate into this film, forming an intermediate compound of variable chemical composition with O and Mo. Under conditions of considerable cathodic polarization this compound is reduced at the cathode to form the Fe−Ni−Mo alloy. The relative rates of two parallel reactions have the determining influence on the cathodic process as a whole: incomplete reduction of Mo(VI) with formation of a film of lower Mo compounds, and subsequent reduction of this film jointly with Fe and Mo to form the electrolytic Fe−Ni−Mo(VI) in solution, the cathodic current current density, and solution pH. (auth)

43561 IMPROVED CONTRAST BY VAPOR PHASE DEPOSITION OF ZINC SELENIDE FOR THE METALLOGRAPHIC INVESTIGATION OF TRANSITION ZONES. Huenlich, Arnold; Schreibmaier, Jochen; Spieler, Klaus (Kernforschungszentrum, Karlsruhe, Ger.). Prakt. Metallog.; 9: No. 4, 227-9(Apr 1972). (In German and English).

The enhancement of contrast by vapor phase deposition of zinc selenide was used in the investigation of transition zones between reactor fuel and the material of the fuel element can (UN−V) and reaction zones in the dispersion fuel (UAl_3−Al). The results showed that the method does not necessarily lead to improved assessment or additional information from all regions of the microstructure. However, it does have certain advantages in the investigation of the transition zones. It is not the universal solution for poor contrast, but an easy and successful method in many special problems. (P.C.H.)

43562 TRANSFER COEFFICIENTS OF METALS ACROSS COATED-ELECTRODE WELDING ARCS. Richter, Fritz. Schweisstechnik (Berlin); 21: No. 1, 7-10(Jan 1971). (In German).

The economic utilization of alloying metals in coated electrodes is dependent on the transfer coefficient η. The values of η were experimentally determined for Co, Ni, Cr, Mo, W, and Mn. The highest values (~96%) were found in the cases of Ni, Co, and Mo. For all the addition metals economic introduction is only possible with a CaF_2−$CaCO_3$ coated electrode since transfer coefficient values drop considerably in the case of mixed or pure Ti-type coated electrodes. An alloying factor table showing the amount of metal for various coating thicknesses is constructed. (Metals Abstr.)

43563 THERMODYNAMIC PROPERTIES OF URANIUM–ANTIMONY ALLOYS. Seregin, V. M.; Poyarkov, A. M.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P. At. Energ. (USSR); 32: No. 5, 419-21(May 1972). (In Russian).

The thermodynamic properties of liquid solutions and of the compound USb_2 were studied by the emf method in the interval 630 to 850°C, using the cell: $U_s|KCl-LiCl-3$ wt. % $UCl_3|U-Sb_{liq}$. Equilibrium emf values were independent of U concentrations over the range 6 to 13.5%. The activity of U deviated strongly from Raoult's Law. The dissolution of U in liquid Sb was exothermic; 62 cal of heat were liberated by the formation of 1.0 g atom of solution (0.2 at. % U). Data are given on the solubility of U in liquid Sb. (K.S.W.)

43564 INVESTIGATION OF THE THERMODYNAMIC PROPERTIES OF BINARY LIQUID ALLOYS OF SILVER AND GOLD WITH GALLIUM, INDIUM, AND GERMANIUM. Predel, Bruno; Schallner, Udo (Univ., Muenster, Ger.). Z. Metallk.; 63: No. 6, 341-7(Jun 1972). (In German).

The excess values of the free enthalpies of mixing of binary systems of silver and gold with gallium, indium, and germanium were obtained from the partial free enthalpies of mixing of zinc in liquid alloys of the ternary systems Ag–Ga–Zn, Ag–In–Zn and Ag–Ge–Zn as well as Au–Ga–Zn, Au–In–Zn, and Au–Ge–Zn as determined from the emf of a galvanic concentration cell. The resulting excess values of the integral free enthalpies of mixing were negative in accord with the tendency of the systems to compound formation. From the variation of the excess values of the partial free enthalpies of mixing of silver or gold at infinite dilution with the relative atomic volume difference of the alloy components, bonding and misfit contributions could be estimated. The bonding contributions depend linearly on the electronegativity of the common components of a given system series. The discussion of the excess values of the free enthalpies of mixing obtained showed that apparently considerable heteropolar bonding contributions are to be found in the investigated liquid silver and gold alloys. (auth)

43565 HYDROGEN SUPERSTRUCTURE OF W(110). Matysik, K. J. (Cornell Univ., Ithaca, N. Y.). Surface Sci.; 29: No. 1, 324-8(Jan 1972).

A reflection high-energy electron diffraction (RHEED) study was made of sorbed H and its superstructure on the W(110) surface and the conditions necessary to image the reciprocal lattice. The reciprocal lattice of the H structure was mapped and found to consist of a (2 × 1) domain structure. Heating to 550°K causes the structure to disappear. (D.L.C.)

43566 PREPARATION OF CONTIGUOUS CHEMISORBED ADLAYERS BY SEQUENTIAL DEPOSITION AND SURFACE MIGRATION. Klein, Ralph (National Bureau of Standards, Washington, D. C.). Surface Sci.; 29: No. 1, 309-16(Jan 1972).

A technique was developed for preparing a metal surface with two separate but continguous chemisorbed phases. A molecular beam assembly is used in which the field emitter tip of a field emission microscope is the target. Gases are deposited on the emitter tip so that both chemisorbed and physisorbed layers are present, and the tip is heated so that the physisorbed layer migrates to the uncovered surface. Separation of O_2 and CO, and N_2 and H_2 on W, Re, and Rw emitters using the technique is demonstrated with field emission patterns. (D.L.C.)

43567 CARBON STRUCTURE ON THE Re(0001) SURFACE. Zimmer, Robert S.; Robertson, W. D. (Yale Univ., New Haven). Surface Sci.; 29: No. 1, 230-6(Jan 1972).

A six-domain $(7 \times \sqrt{19})$ LEED pattern from the (0001) rhenium surface is attributed to carbon. (auth)

43568 IONIC MONOLAYERS ON METALS. I. LAYERS OF LIKE IONS. Carroll, C. E.; May, John W. (Franklin Inst., Swarthmore, Pa.). Surface Sci.; 29: No. 1, 60-84(Jan 1972).

An estimate is made of the energy of a layer of like ions adsorbed on an atomically smooth face of a metal crystal. Only adions of large radius are considered, so that the method of electrostatic images can be used in evaluating the energy. For periodic layers of high density, large deviations from the dipole approximation of Topping are found. Also, the increase in electrostatic energy accompanying disordering of a layer is estimated and used the result to discuss thermal disordering of Na and Cs layers on W(110). It is emphasized that the charge transfer to a layer of like ions must be small. For example, O and S anions of integral charge cannot form densely packed layers on metals. (auth)

43569 BORO–CHROMIUM SYSTEM. Lucco Borlera, M.; Pradelli, G. (Politecnico, Turin). Met. Ital.; 63: No. 2, 61-6; 80(Feb 1971). (In Italian).

A diagram of the B–Cr binary systems up to 50% atomic of boron has been studied. In this area of the system four phases have been identified: a solid solution of α boron in the cubic chrome balanced body; a hexagonal β shape which, at 1100°C can contain from 2.5 to 13 at. % boron. The β phase was stable up to 1550°C. In the composition range between 28.75 and 32.5 at. % of boron, a rhombic phase γ was formed, with a structure analogous to the compound Mn_4B, such a phase was always richer (even if in small quantity) in chromium than that which corresponds to the formula Cr_2B. γ solids gave a complete solid solution with the Mn_4B boron. For quantities of boron between 37.5 and 39.75 at. % uniphasal δ solids were obtained, with a tetragonal structure of composition near to Cr_5B_3. Phases α and γ gave, at 1570°C, a eutectic corresponding to a boron content of 11.3%. Solids γ and δ melted inconsistently; the first at 1855°C and the second at 1895°C. (auth)

43570 DEVELOPMENT OF A HIGH-RESISTANCE TITANIUM ALLOY. Molinier, R.; Syre, R. Atti Notiz. (Publ. in Met. Ital.); 26: No. 2, 59-63(Feb 1971). (In Italian).

The steps in the development and testing of the high resistance alloy Ti–6% Al–6% V–2% Sn–0.5% Cu–0.5% Fe are outlined. Laboratory tests were made to define the composition, and semi-industrial tests were made on the thermal treatment and the comparison of the tempering characteristics of the alloy with those of Ti–6% Al–6% V. The industrial tests concentrated on the resistance to fatigue and to crack propagation. (J.S.R.)

43571 THERMAL TREATMENT OF TITANIUM AND ITS ALLOYS. Tricot, M.; Seraphin, L. Atti Notiz. (Publ. in Met. Ital.); 26: No. 2, 64-7(Feb 1971). (In Italian).

The metallurgical bases and the method for the heat treatment of Ti and its alloys are summarized. The thermal treatment was for the purpose of obtaining properties suitable for its use. Means of avoiding contamination during the thermal treatment are discussed. (J.S.R.)

43572 CHARACTERISTIC PROPERTY OF THE PRODUCTION OF TITANIUM ALLOYS. Gerhardt, A.; Knorr, W. (Fried Krupp GmbH, Essen). Atti Notiz. (Publ. in Met. Ital.); 26: No. 2, 69-70(Feb 1971). (In Italian).

The primary properties of semi-industrial products obtained from large ingots of titanium alloys produced by arc remelting with consumable electrodes are briefly summarized. (J.S.R.)

43573 STRAIN HARDENING AND RECRYSTALLIZATION BEHAVIOR OF SINTERED Ta AND Ta MELTED IN ELECTRON BEAMS. Alheritiere, E.; Moisan, J.; Molinier, R.; Syre, R. (Trefimetaux, Argenteuil, France). Metaux (Corros.-Ind.); 47: No. 558, 51-8(Feb 1972). (In French).

The strain hardening and recrystallization behavior of molten Ta and sintered Ta was studied. A heterogeneous deformation mechanism was observed for the molten metal, the strain hardening of large grains varying with their orientations. Annealing between 1000 and 1100°C produced recovery without recrystallization for the slightly hardened grains. The strongly hardened areas were found to recrystallize by nucleation and growth, an equiaxial grain being obtained. An annealing at 1200°C causes a recrystallization of the long grains which have recovered and the whole structure becomes equiaxial and regular, but coarse. The deformation texture of the sintered metal was found to be more homogeneous, and the recrystallization more regular and fine. (France)

43574 STRUCTURE OF THE CHROMIUM–COPPER–ZIRCONIUM TERNARY EQUILIBRIUM DIAGRAM IN THE COPPER-RICH REGION. Fedorov, V. N.; Zakharov, M. V.; Osintsev, O. E.; Kucherov, V. I. (Moscow Inst. of Steel and Alloys). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 103-4(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 181-2(Jan 1972).

The results of an investigation of the copper corner of the chromium–copper–zirconium ternary equilibrium diagram up to 1.5% chromium and 1.3% zirconium are presented. At temperatures below 950°C the isothermal sections show four phase regions: α(Cu), $\alpha + \beta$(Cr), $\alpha + \gamma(Cu_3Zr)$, and $\alpha + \beta + \gamma$. The Cu–Cr_2Zr radial section is not quasibinary. (auth)

43575 DENDRITIC MORPHOLOGY IN Zn–Cd DILUTE ALLOYS. Audero, M. A.; Biloni, H. (Comision Nacional de Energia Atomica, Buenos Aires). J. Cryst. Growth; 12: No. 4, 297-308(Apr 1972).

In Zn–Cd dilute alloys the transition from cells to dendrites was analyzed for increasing values of constitutional supercooling. The substructure evolution was through two simultaneous and continuous mechanisms: arm formation as a result of the node mechanism and cell elongation in a direction parallel to the basal plane. For maximum conditions of constitutional supercooling the substructure was composed of dendrites growing cooperatively in a $\langle 10\bar{1}0\rangle$ direction. The use of epitaxial film techniques showed that the dendrites have a cruciform cross-section with plate-like arms. From these plates, develop uniformly spaced higher order arms which grow either on the basal plane in equivalent $\langle 10\bar{1}0\rangle$ cryatallographic directions or on the $(\bar{1}2\bar{1}0)$ plane in a $\langle 0001\rangle$ direction. The same technique used near the frozen interface proved that the plates are the result of a coarsening mechanism occurring during solidification. The substructure segregation pattern has, as a fundamental characteristic, a higher segregation in planes parallel to the basal plane than in any other orientation. (auth)

43576 SYSTEMS OF HIGHLY REFRACTORY OXIDES. Lopato, L. M.; Shevchenko, A. V.; Kushchevskii, A. E. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 70-3(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 88-92(Jan 1972).

Dynamic methods of physicochemical analysis, such as high-temperature x-ray diffraction and differential thermal analyses (DTA), were used to study the system Ge_2O_3–SrO in the temperature range from 1300 to 2400°C. The phase diagram of the system was characterized by: the formation of compounds having the 1 : 2 ($SrGd_4O_7$) and 1 : 1 ($SrGd_2O_4$) compositions; the existence of regions of solid solutions based on the starting oxides; a lowering of the polymorphic transition temperatures of the B-, A-, H-, and X-forms of Gd_2O_3 in the presence of SrO additions. The 1 : 1 composition was stable in the whole temperature range investigated, from 1300 to the melting point, 2120°C. DTA data showed that the 1 : 2 compound formed at a temperature of 1905°C and existed up to its melting point, 2200°C. The maximum solubility of SrO in the β-form of Gd_2O_3 was 5 mole % (1840°C) and at 1300°C fell to 1 mole %. At the same time, the elementary cell parameters changed. (P.C.H.)

43577 DIAGRAMMY SOSTOYANIYA I FAZOVYE PREVRASHCHENIYA SPLAVOV URANA. (Phase Composition Diagrams and Phase Transitions of Uranium Alloys). Ivanov, O. S. (ed.). Moscow; Izdatel'stvo Nauka (1972). 252p.

The open literature to 1969 was critically reviewed for phase composition and transition data on 70 binary, 90 ternary, and 11 quaternary systems of uranium and its alloys. In addition, isothermal sections are drawn to show many non-equilibrium and metastable states of binary and ternary systems. The kinetics and mechanisms of transformations, and the structure of metastable states are examined in detail. 566 references. (K.S.W.)

43578 BEHAVIOR OF CADMIUM IN NaCl SOLUTIONS. Kadyrov, M. Kh.; Golubev, A. I. Zashch. Metal.; 6: No. 5, 569-71(1970). (In Russian).

Of the three current maxima on the cathodic polarization curve in NaCl solutions at room temperature, the first is associated with reduction of $Cd(OH)_2$, the second with accumulation of $CdCl_2$ on the surface, and the third with reduction of CdO. (Referativnyi Zh.)

43579 ADSORPTION OF BARIUM OXIDE ON A CUTTING POINT AT 77°K. Kirsanova, T. S.; Tumareva, T. A.; Domozhirov, S. G. (Leningrad Polytechnic Inst.). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 114-15(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 196-8(Jan 1972).

The formation of films of barium oxide on a tungsten cutting edge at a temperature close to 77°K has been investigated by field emission microscopy. (auth)

43580 INTERACTION BETWEEN MOLECULES IN ADSORPTION AND ABSORPTION PROBLEMS. III. ADSORPTION OF OXYGEN ON TRANSITION METALS AND GOLD. Fedyanin, V. K. (Physical-Chemical Scientific Research Inst., Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 65-6(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 119-21(Jan 1972).

Results of previous analyses of adsorption problems, together with results for the chemisorption of oxygen or transition metals and gold, are used in determining a parameter for the effective repulsion of adsorbed atoms. (auth)

43581 STRUCTURE OF MELTS IN BINARY METALLIC SYSTEMS WITH A EUTECTIC EQUILIBRIUM DIAGRAM. Zalkin, V. M. (All-Union Correspondence Inst. of Economics, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 1, 5-8(Jan 1972).

Translated from Zh. Fiz. Khim.; 46: No. 1, 8-14(Jan 1972).

It has been shown that in many binary metallic systems with a eutectic, the position of the eutectic point is connected in a definite manner with the heat of mixing ΔH of these systems. The greater ΔH_{max} for the system, the further the eutectic point is displaced from the equiatomic composition towards the side of one of the components (usually the lower-melting one). The results of investigations of liquid alloys of eutectic systems by quenching or centrifuging allow conclusions about the restricted mutual solubility of the components of eutectic systems in the liquid state (over a definite range of concentrations) to be drawn. Owing to the small interfacial tension, one of the phases is spontaneously dispersed and a thermodynamically stable lyophilic two-phase disperse system is formed. Consequently macroscopic layering is not observed in the immiscibility range in these systems. In several systems, the layering of liquid alloys with composition corresponding to ΔH_{max} can be brought about by centrifuging at moderate accelerations. The eutectic composition is characterized by high dispersion of the colloidal particles and their strong interaction with the dispersion medium. The composition of the eutectic is determined by the (definite and constant for the given system) ratio of the components, at which all the dispersion medium is solvated by a cloud of the colloidal particles. (auth)

43582 SHOCK RESPONSE OF POROUS COPPER, IRON, TUNGSTEN, AND POLYURETHANE. Linde, Ronald K.; Seaman, Lynn; Schmidt, David N. (Stanford Research Inst., Menlo Park, Calif.). J. Appl. Phys.; 43: No. 8, 3367-75(Aug 1972).

For guidance in constructing a mathematical model for porous materials, impact tests were conducted with a light-gas gun on samples of porous copper, iron, tungsten, and polyurethane foam using manganin and quartz transducer techniques. Both Hugoniot (thick flyer) and attenuation (thin flyer) experiments were conducted on the porous metal specimens, which were initially at 70% of solid density. The Hugoniot elastic limits were 1, 2.5, and 10 kbar and maximum stresses attained were 60, 50, and 140 kbar in copper, iron, and tungsten, respectively. In impacts above 20 kbar, porous iron and copper compacted to solid but tungsten was not consolidated at 140 kbar. The mathematical model was incorporated into a one-dimensional wave-propagation computer program, and stress histories were computed to compare with the transducer records. Computed peak stresses and arrival times agreed with the recorded values within 20%. (auth)

43583 ANISOTROPIC SELF-DIFFUSION IN ERBIUM SINGLE CRYSTALS. Spedding, F. H.; Shiba, Koreyuki (Ames Lab., Iowa. Iowa State Univ., Ames). J. Chem. Phys.; 57: No. 2, 612-7(15 Jul 1972).

The rate of self-diffusion in single crystals of erbium has been studied over the temperature range from 1202 to 1412°C using a radioactive tracer (^{169}Er)-sectioning (grinding) technique. The diffusion coefficients along the a axis (D_a) and along the c axis (D_c) of the close packed hexagonal structure are: $D_a = (4.51 + 0.55, 4.51 - 0.49) \exp [- (72.27 \pm 0.36) \times 10^3/RT$ cm^2 sec, $D_c = (3.71 + 0.87, 3.71 - 0.71) \exp [- (72.05 \pm 0.65) \times 10^3/RT]$ cm^2/sec. By making use of Mullen's table for the diffusion of hcp metals by the vacancy mechanism, the ratio of jump frequencies is determined to be $\omega_c/\omega_a = 0.85 \exp (+270/RT)$ where ω_c and ω_a are frequency out of the basal plane and frequency in the basal plane, respectively. (auth)

43584 REFLECTIVITIES OF Hg–In LIQUID ALLOYS FROM 0.31 TO 9 eV. Siskind, Barry; Boiani, James; Rice, Stuart A. (Univ. of Chicago). Phys. Rev. Lett.; 29: No. 5, 259-62(31 Jul 1972).

The reflectivity of liquid Hg–In alloys was measured at near normal incidence from 0.14 to 4.0 μm. The results deviate from the predictions of the Drude free-electron model. This is attributed to an unusual two-peaked density-of-states profile in liquid In and to concentration gradients of the components in a layer at the surface of the alloy. (auth)

43585 STRAIN RELEASE METHOD OF STUDY OF MICROPLASTICITY OF SOLIDS. Chambers, Robert H. (Univ. of Arizona, Tucson); Filloux, Jean H. Int. J. Nondestruct. Test.; 4: No. 1, 53-68(Jun 1972).

All solids flow a small amount in response to the application of stresses smaller than those necessary to produce macroyield (i.e., yield that produces a permanent deformation strain greater than 0.1%). This microflow has been extensively studied for at least two reasons: because it gives important information concerning the motion of dislocations and dislocation-point-defect interactions in solids and because of the increasing technological need to hold closer dimensional tolerances. Microflow is generally temperature dependent, frequently exhibiting a number of different thermally-activated components. In some solids there is a close relation between the thermally-activated microflow mechanisms and the mechanisms responsible for large-scale macroflow. A measurement technique called the strain release method that permits the observation of most of these thermally-activated mechanisms in one relatively simple measurement is described. The technique also permits the measurement of the activation energy and relaxation strength of each thermally-activated component under conditions prevailing during the transition from microflow to macroflow. The method thus bridges the gap between standard internal friction and microcreep methods of microflow on the one hand and the standard strain-rate methods of macroflow, on the other. (auth)

43586 DIFFUSION DATA. Woehlbier, F. H. (ed.). Diffus. Data; 6: No. 1, 1-331(1972).

New information on diffusional mass transport in and through crystalline and amorphous solids and in liquid substances that are solid at normal temperature and pressure is presented. The information is divided into the following groups of host substances: solid metals and alloys; liquid metals and alloys; semiconductors (excepting oxides); simple and complex oxides, their mixtures and solutions (including amorphous substances); halides and other ionic crystals; and miscellaneous (organic crystals, carbides, etc.). Within each section, the data are presented in alphabetical order of the host substances. Separate author, host substance, and phenomenological topic indexes are also included along with cumulative indexes for Vol. 1 through 5. A directory of diffusion researchers is also included. (250 references). (P.C.H.)

43587 ABSOLUTE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF MATERIALS. Liermann, J. (CEN de

Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 167, 53-8(Feb 1972). (In French).

An apparatus, which utilizes the axial gradient cylinder method for the absolute measurement of the thermal conductivity of metals, is described. Particular emphasis is given on the precautions taken to eliminate heat losses, obtain a uniform flux, and measure the temperatures. This apparatus enabled the thermal conductivity to be determined (50 to 600°C) for the materials constituting the metallic U fuel elements. Results of measurements made on a magnesium—zirconium alloy and pure iron are given. (France)

43588 SONDERMETALLE. METALLURGIE/HERSTELLUNG/ANWENDUNG. (Special Metals. Metallurgy, Production, and Uses). Kieffer, Richard; Jangg, Gerhard; Ettmayer, Peter. Vienna; Springer-Verlag (1971). 485p. $45.70.

The history, raw materials and abundance, production statistics and price conditions, physical, mechanical and chemical properties, primary winning and refining, alloys and applications of the less common metals, including the alkali metals (Li, Ru, Ce), Be and the alkaline earth metals, the Sc group, the actinides, Ti, Zr and Hf, V, Nb, and Ta, Cr, Mo and W, Mn, Tc and Re, Co and the Pt metals, Ga, In and Tl, B, Si, and Ge are presented in treatise form. A general review of the atomic structure, electrical and thermal conductivity, and extraction and refining metallurgy of the special metals is provided. (Metals Abstr.)

Radiation Effects

Refer also to abstracts 42896, 42901, and 44519.

43589 (COO—3158-7) A CRITIQUE OF L. M. BROWN'S "A SIMPLE EXPLANATION OF VOIDS IN MATERIALS UNDER IRRADIATION." Seidman, David N.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). 9 Jun 1972. Contract AT(11-1)-3158. 4p. Dep. NTIS.

The critique is presented to refute a conclusion of Brown, NSA 26: 33977, that an equilibrium array of voids may be a very general consequence of irradiation at large enough dose to produce a steady state. The conclusion is refuted in the critique because it is based on an erroneous application of equilibrium thermodynamics to a highly non-equilibrium situation. (J.R.D.)

43590 (TID—25976) MINIATURE URANIUM FUEL PLATES COOLED BY LIQUID HELIUM FOR IRRADIATION DAMAGE STUDIES. Southern, A. L.; Coltman, R. R. Jr.; Klabunde, C. E. (Oak Ridge National Lab., Tenn.); Hemmerich, J. L. (Kernforschungsanlage, Juelich (West Germany)). [nd]. 9p. (CONF-720803—3). Dep. NTIS.

From Cryogenic engineering conference; Boulder, CO. (9 Aug 1972).

Two small plates cut from a highly enriched uranium fuel element are used to produce a fission neutron flux in the sample chamber of an existing neutron irradiation cryostat. A flux of 4.1×10^{11} n/cm^2/sec is produced at the center of a 1 mm gap between the plates, which produce only 17 watts of nuclear heat. Irradiations of 11 days each have been made at 4.86, 90, 200, and 290°K of specimens for the study of fission neutron damage by x-ray, electron microscopy, and electrical resistivity. (auth)

43591 (ZJE—116) INFLUENCE OF THE INITIAL CONDITION OF REACTOR PRESSURE VESSEL STEELS ON THEIR RADIATION DAMAGE. Brumovsky, M.; Havel, S. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1971. 33p. (CONF-710552—1). Dep. NTIS (U. S. Sales Only).

From Meeting on pressure vessels; Vienna, Austria (10 May 1971).

To get acquainted with the influence of the initial stage of material, which is one of the most important factors, on the radiation damage in pressure vessel steels, a study of the following factors has been carried out: influence of carbon and manganese contents in model Fe—C—Mn type alloys; influence of microstructure in A 212 B type steel (ferrite + pearlite), Mn—Ni—Mo—Nb (martensite, bainite, ferrite-pearlite) and Mn—Ni—Cr (ferrite-pearlite, bainite) types low-alloy steels; influence of chemical composition of individual type of steels on transition temperature increase; influence of initial mechanical properties (yield strength) on their change during irradiation; influence of initial concentration of interstitial elements; and influence of artificial mechanical aging. The results showed that these influences can take part together and in most cases their effects can be summarized so that the importance of their study, from the point of view of their existence and possible interactions, has been approved. (auth)

43592 EVAPORATION OF A SILVER—INDIUM (5 AT. %) ALLOY UNDER CONDITIONS OF IRRADIATION OF ITS SURFACE WITH β PARTICLES. Sklyarenko, I. Ya.; Priselkov, Yu. A.; Zimakov, I. E. Sov. Radiochem. (Engl. Transl.); 13: No. 6, 955-9(1971).

Translated from Radiokhimiya; 13: No. 6, 920-4(1971).

The evaporation of pure metallic silver and a silver—indium alloy (5 at. % indium) was studied after irradiation of the surface of the samples with β particles and without irradiation under conditions of high vacuum. It was discovered that the dose used does not influence the evaporation of pure silver but has a significant influence on the evaporation of the alloy. The temperature dependences of certain parameters of the evaporation of pure silver and the components of the alloy were calculated. (auth)

43593 RADIATION BLISTERING IN NIOBIUM. Donhowe, J. M.; Klarstrom, D. E.; Sundquist, M. L.; Weber, W. J. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 36(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43594 IRRADIATION SWELLING AND GROWTH IN URANIUM AND OTHER ANISOTROPIC METALS. McDonell, William R. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 185-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43595 LOW-TEMPERATURE TENSILE PROPERTIES OF IRRADIATED A-286. Shogan, R. P.; DeMastry, J. A. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 1, 205-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43596 STANDARD SPECIFICATIONS FOR MINIMIZING RADIATION EFFECTS IN NUCLEAR STRUCTURAL METALS. Steele, L. E.; Hawthorne, J. R. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 226(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43597 DEFECT PRODUCTION IN NEUTRON IRRADIATIONS INFERRED FROM COMPUTER EXPERIMENTS. Doran, D. G. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 241-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43598 POSTIRRADIATION RECOVERY OF IRRADIATION DAMAGE. Dollins, C. C. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 243(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43599 SWELLING RESISTANCE OF A HIGH NICKEL ALLOY. Appleby, W. K. (General Electric Co., San Jose, Calif.); Sandusky, D. W.; Wolff, U. E. Trans. Amer. Nucl. Soc.; 15: No. 1, 243-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43600 SOLUTE EFFECTS ON DEFECT MICROSTRUCTURE IN IRRADIATED IRON. Smidt, F. A. Jr.; Sprague, J. A. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 244-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43601 RADIATION-INDUCED STRENGTHENING AND INTERGRANULAR FRACTURE IN ALUMINUM. Farrell, K.; King, R. T. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 245(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43602 ELECTRON IRRADIATION DAMAGE IN ALUMINUM NEAR THE THRESHOLD ENERGY. Wolfenden, Alan (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 246 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43603 DAMAGE FUNCTION FOR SWELLING IN TYPE 304 STAINLESS STEEL. McElroy, W. N.; Simons, R. L.; Doran, D. G.; Straalsund, J. L. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 249-50(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43604 SWELLING IN TYPES 304 AND 316 STAINLESS STEELS BOMBARDED WITH 5-MeV NICKEL IONS. Johnston, W. G. (General Electric Research and Development Center, Schenectady, N. Y.)

Rosolowski, J. H.; Turkalo, A. M.; Lauritzen, T. Trans. Amer. Nucl. Soc.; 15: No. 1, 250-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43605 EFFECT OF CYCLOTRON-INJECTED HELIUM ON FATIGUE CHARACTERISTICS OF STAINLESS STEEL. Serpan, C. Z. Jr.; Smith, H. H.; Pieper, A. B. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 251 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43606 EFFECTS OF COLD WORK AND HEAT TREATMENT ON SWELLING IN TYPES 304 AND 316 STAINLESS STEELS. Straalsund, J. L.; Brager, H. R. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 251-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43607 NEUTRON SPECTRUM EFFECTS (ETR vs EBR-II) ON THE MECHANICAL PROPERTIES OF AUSTENITIC STAINLESS STEEL. Bauer, A. A. (Battelle Columbus, Labs., Ohio); Kangilaski, M. Trans. Amer. Nucl. Soc.; 15: No. 1, 252-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43608 EFFECT OF IRRADIATION ON TITANIUM-MODIFIED TYPE 316 STAINLESS STEEL. Bloom, E. E.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 253-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43609 CHANNEL FRACTURE IN IRRADIATED EBR-II TYPE 304 STAINLESS STEEL. Hunter, C. W.; Fish, R. L.; Holmes, J. J. (Hanford Engineering Development Lab., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 254-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43610 POSTIRRADIATION RUPTURE LIFE OF ANNEALED TYPE 316 STAINLESS STEEL. Lovell, A. J. (Hanford Engineering Development Lab., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 255-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43611 EFFECT OF FAST NEUTRON IRRADIATION ON AISI 316 STEEL TUBE. Kawasaki, Satoru; Fukaya, Kiyoshi; Nagasaki, Ryukichi (Japan Atomic Energy Research Inst., Ibarki). Nippon Genshiryoku Gakkaishi; 14: No. 6, 283-9(Jun 1972). (In Japanese).

Fast neutron irradiation in the D.F.R. to fluences of about 1 × 10^{22} nvt (>0.1 MeV) was performed on two kinds of cold worked AISI 316 stainless steel pipes (6% and 18% cold work) in the 565 to 660°C range. Postirradiation examination revealed that fast neutron radiation enhances recovery of the cold worked structure. The 18% cold worked specimen proved more ductile when irradiated at 565° or 600°C, as compared with non-irradiated sample, but when irradiated at 660°C, severe embrittlement was observed. On the other hand, the 6% cold worked specimen showed neither radioinduced ductility increase nor severe embrittlement. (auth)

Other Materials

Refer also to abstracts 43219, 43222, 43223, 43457, 43461, 44517, and 44535.

43612 (IS-T-510) REDUCTION OF MOLYBDENUM AND TUNGSTEN HALIDES IN SODIUM TETRAHALOALUMINATE MELTS. Dorman, William Clifford (Ames Lab., Iowa). May 1972. Contract W-7405-eng-82. 42p. Dep. NTIS.

Thesis.

Aluminum reduction of molybdenum and tungsten higher chlorides and bromides in the appropriate sodium tetrahaloaluminate melt has been found to be a convenient and safe procedure for the preparation of the corresponding molybdenum and tungsten(II) chlorides and bromides in good yields. The anhydrous dihalides $(M_6X_8)X_4$, their hydrates $(M_6X_8)X_4 \cdot 2H_2O$, and their acid hydrates $(H_3O)_2[(M_6X_8)X_6] \cdot 6H_2O$ are all known to contain the hexanuclear metal cluster configuration with eight bridging internal halides. The dichloride and dibromide of molybdenum were prepared by reduction of $MoCl_5$ with Al in NaCl−$AlCl_3$, and with Al in NaBr−$AlBr_3$, respectively. The reactions were carried out in a sealed Pyrex ampoule at 450° for two days on a wrist action shaker. After reaction, the products were ground and extracted with water and then with ethanol to remove all of the metal halide cluster species. The volumes of these supernatant solutions were reduced and the acid hydrates, $(H_3O)_2[(Mo_6X_8)X_6] \cdot 6H_2O$, could be crystallized from solution by the addition of a large excess of the appropriate concentrated hydrohalic acid. These acid hydrates were decomposed in vacuo at ca. 200° to give the corresponding dihydrate, $(Mo_6X_8)X_4 \cdot 2H_2O$. The preparations of the tungsten(II) chloride and bromide were parallel to the techniques and procedures used in the preparations of the analogous molybdenum compounds. Tungsten(II) chloride was prepared by reduction of WCl_6 with Al in NaCl−$AlCl_3$. The dibromide was prepared by reduction of WBr_5 in NaBr−$AlBr_3$, also with Al metal. The reactions were carried out in sealed Vycor reaction tubes at 550°, for one and two days respectively, in a rocking furnace. After reaction the products were treated in the same manner as for the molybdenum species to give the corresponding acid hydrates, $(H_3O)_2[(W_6X_8)X_6] \cdot 6H_2O$. The acid hydrates were decomposed in vacuo at ca. 350° to produce the corresponding anhydrous compounds, $(W_6X_8)X_4$. Analytical data taken on the dihydrates and the anhydrous compounds confirmed halogen to metal ratios of 2. (auth)

43613 (LA-DC-72-148) HIGH EXPLOSIVE MATERIALS. Popolato, A. (Los Alamos Scientific Lab., N. Mex.). 1970. 20p. (CONF-720303-7). Dep. NTIS.

From twelfth annual symposium of the ASME; Albuquerque, N. Mex. (2 Mar 1972).

Some of the more common detonating high explosive compounds and mixtures made with these materials are described. The properties of these materials from the standpoint of detonation characteristics, initiation, thermal decomposition, and thermal stability are also discussed. A brief description of processing techniques used to produce charges is included. The thermal properties of a few of the more thermally stable high-explosive compounds are presented. (auth)

43614 RADIATION CONDITIONING OF MONOMERS FOR CONCRETE-POLYMER MATERIALS. Fontana, J.; Steinberg, M.; Colombo, P. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 145-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43615 FRICTION OF GRAPHITE IN INERT AND HYDROGEN ATMOSPHERES. Easton, D. S.; Clausing, R. E. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 206-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43616 STORED ENERGY RELEASE IN IRRADIATED GRAPHITE. Jones, E. E. (Convair Aerospace Div., Fort Worth, Tex.); McDaniel, R. H.; DeMastry, J. A. Trans. Amer. Nucl. Soc.; 15: No. 1, 208(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43617 UNIQUE BINDER SYSTEMS FOR THE FABRICATION OF NUCLEAR GRAPHITES. Whittaker, M. P.; Miller, F. C. (Great Lakes Research Corp., Elizabethton, Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 208-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43618 RADIATION EFFECT ON THE SURFACE STRUCTURE OF EGYPTIAN KAOLINITE. Abdel Aziz, N. E.; Dawood, R. I.; Mohamed, A. A.; El Adl, E. I. (National Research Center, Cairo). Indian J. Phys.; 45: No. 5, 200-2(May 1971).

Thesis.

This investigation was carried out on Egyptian kaolinite clay obtained from Mosabaa Salama in Sinai Peninsula in U.A.R. Normal surfaces at room temperature were irradiated with x rays for different times from one to four hours, replicated, and then studied using the electron microscope. Normal surfaces showed different features depending on the time of irradiation. These features appeared at delayed stages for etched surfaces after being irradiated. (auth)

43619 RADIATION DOPING OF SILICON. Kharchenko, V. A.; Solov'ev, S. P. (Scientific-Research Physical-Chemical Inst., Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 12, 1903-6(Dec 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 12, 2137-41(Dec 1971).

The general principles of incorporation of a donor impurity (phosphorus) into silicon by means of nuclear reactions involving capture of slow neutrons by the isotope ^{30}Si during irradiation in a nuclear reactor are analyzed. Results of a study on the distribution of the phosphorus are presented. They show that radiation doping can give a higher degree of uniformity of the resistivity distribution over the bulk of a doped silicon crystal than that attainable by the usual methods of doping. The electrophysical properties of radiation-doped silicon make it suitable for the production of semiconductive devices. (auth)

43620 EFFECT OF HEAT TREATMENT ON THE ELECTROPHYSICAL PROPERTIES OF RADIATION-DOPED SILICON. **Kharchenko, V. A.; Smirnov, B. V.; Solov'ev, S. P.; (and others) (Scientific-Research Physical-Chemical Inst., Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 12, 1907-10(Dec 1971).**

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 12, 2142-5(Dec 1971).

The effects of heat treatment on the electrophysical properties of radiation-doped silicon were studied. It was found that the electrophysical properties of irradiated silicon approach the theoretical values after 1 h of annealing at about 800°C, and change only slightly during further heat treatment at up to 1300°C. Etching revealed that the changes in defect structure of reactor-irradiated silicon are different from silicon obtained by other methods. (auth)

43621 PLASTICS IN NUCLEAR TECHNIQUES. **Wilski, H. Afinidad; 28: No. 289, 829-32(Sep 1971). (In Spanish).**

A brief review is given of the use of plastics in nuclear techniques. The use of polyethylene as a moderator, shield, and sample recipient is described. Plastics are also used as decontaminable laboratory installations. The problems of resistance to radiation are briefly considered. (J.S.R.)

43622 THERMAL CONDUCTIVITY OF CARBON MATERIALS AT HIGH TEMPERATURES BY A MODULATED ELECTRON BEAM TECHNIQUE. **Tanaka, Takaho; Suzuki, Hiroshige (Tokyo Inst. of Tech.). Nippon Genshiryoku Gakkaishi; 14: No. 6, 274-7(Jun 1972). (In Japanese).**

The thermal diffusivities of carbon materials were determined over the temperature range from 1,300 to 1,900°C, by using the modulated electron beam method. The thermal conductivities were calculated from the diffusivity values obtained by this method and the values of heat capacity available in published literature. The resulting data were found to possess anisotropic properties, which were attributable to the method of preparation of the materials. The largest anisotropy was observed in pyrolytic graphite, whose ratio of anisotropy was about 100 in this temperature range. The anisotropy ratio of mold pressed natural graphite was about 3, which larger than that of artificial graphite. The thermal conductivities of glassy carbon appeared to be independent of temperature, and were 2.7×10^{-2}, 2.4×10^{-2}, and 2.2×10^{-2} cal/sec/cm/°C for the qualities called GC-30S, GC-30, and GC-20, respectively. (auth)

43623 STABILITY OF ACTIVATED GLASSES TO A BEAM OF ACCELERATED ELECTRONS. **Gavrilenko, T. B.; Karapetyan, G. O. Zh. Prikl. Spektrosk.; 15: No. 6, 1110-12(Dec 1971). (In Russian).**

Borate, silicate, and borosilicate glasses, activated by Tb and Ce in various concentrations, were exposed to a fixed 20-kV electron beam at a current density of 5×10^{-7} A/cm^2. The effect of the beam on the stability of components of the glass and the excitations were evaluated. An enhanced stability to the electron beam was detected for borosilicate glasses at certain ratios of B_2O_3 and SiO_2. (tr-auth)

43624 METHOD OF BONDING A RESINOUS FILM TO A SUBSTRATE USING HIGH ENERGY RADIATION. **Hall, Roger P. (to SCM Corp.). U. S. Patent 3,666,591. 30 May 1972. Filed 3 Oct 1968.**

A process is described for radioinduced coating of a substrate, and especially one having a metallic surface, with a substantially catalyst-free system containing a polymerizable organic unsaturated resin susceptible to free-radical catalysis. In one form, a film of the resin is superimposed upon the substrate while a facing side of either the resinous film or substrate is contacted at any time prior to such radiation with an acid polymer-forming material having a mineral acid group selected from the class consisting of oxygenated sulfur-containing and oxygenated phosphorus-containing groups which are attractive to the substrate, and an organic unsaturated moiety which is sufficiently responsive to high energy radiation to react chemically with the film of the coating resin. Thereafter, the film and substrate are subjected to the high energy radiation to adhere one to the other. The process is also adapted for coating articles with normally air-inhibited, thermosetting resins by a two-step process, in which the resin film is first passed through one treating zone to impart mass integrity and thereby define a sheet; the sheet together with the acid polymer-forming material and the substrate is then passed through another treating zone to complete the cure of the resin and simultaneously adhere the sheet to the substrate, at least one of the treating zones comprising exposure to high-energy radiation. (Official Gazette)

43625 CHANGES IN THE SUBMICROPOROSITY OF STRUCTURAL GRAPHITE DURING IRRADIATION. **Kurolenkin, E. I.; Virgil'ev, Yu. S.; Churilov, Yu. S. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 66-9(Jan 1972).**

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 80-3(Jan 1972).

The pores of mark GMZ graphite can be divided into groups. The fine pores, about 200 Å in size, cause accommodation of the bulkwise growth of the crystals. As a result of irradiation, the volume of the fine pores regularly decreased as the dose increased. Raising the irradiation temperature markedly reduced this effect. (auth)

43626 TERMODINAMICHESKIE SVOISTVA NEORGANICHESKIKH FTORIDOV. (Thermodynamic Properties of Inorganic Fluorides). Galkin, N. P.; Tumanov, Yu. N.; Butylkin, Yu. P. Moscow; Atomizdat (1972). 144p.

Thermodynamic properties of the fluorides of some elements of groups V through VII of Mendeleev's table are presented in tabular form. The elements included are the p-elements P, As, Sb, S, Se, Te, Cl, Br, and I, the d-elements V, Nb, Ta, Cr, Mo, W, Tc, Re, Ru, Rh, Pd, Os, Ir, and Pt, and the f-elements U, Np, and Pu. Basic formulas used in the computation of the thermodynamic functions are stated, and individual atomic and molecular components are discussed. Thermodynamic properties were calculated from the lower temperature limit of 298°K to an upper limit of between 3,000 and 6,000°K by statistical methods. (K.S.W.)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 43019 and 43658.

43627 PROFESSIONAL LEVEL TRAINING IN NUCLEAR MATERIALS SAFEGUARDS. Kanter, Manuel A. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 44(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43628 SAFEGUARDS MINICOURSE. Atkinson, G. D. Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 15: No. 1, 44-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43629 INDIVIDUALLY PACED INSTRUCTION COURSE IN NUCLEAR MATERIALS CONTROL AND SAFEGUARDS. Meyer, Walter; Chezem, C. G.; Eckhoff, N. D. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc.; 15: No. 1, 45(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43630 WORKSHOP APPROACH TO AN INSTRUCTIONAL PROGRAM IN NUCLEAR MATERIALS CONTROL. Carroll, E. E.; Ohanian, M. J. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 15: No. 1, 45-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43631 ISOTOPIC CORRELATION SAFEGUARDS. Christensen, D. E.; Prezbindowski, D. L. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 85-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43632 RANDOMLY PULSED NEUTRON MEASUREMENTS FOR SAFEGUARDS INTERROGATION. Mihalczo, John T. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 156-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Disposal and Storage

43633 (HW-76352) WASTE MANAGEMENT PROGRAM. CHEMICAL PROCESSING DEPARTMENT. Tomlinson, R. E. (comp.) (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 25 Feb 1963. Contract AT(45-1)-1350. 58p. Dep. NTIS.

Declassified 2 Nov 1971.

Essentially all of the fission products produced at Hanford are being stored in about sixty-four million gallons of alkaline slurries in underground tanks ranging from eight to nineteen years old. Research and development programs are being conducted to increase the certainty of confinement of these radioactive materials. The plans presented are believed to be optimum for making use of the environmental advantages and facilities. (auth)

43634 (STI/DOC-10/135) STORAGE TANKS FOR LIQUID RADIOACTIVE WASTES: THEIR DESIGN AND USE. Amalraj, R. V. (International Atomic Energy Agency, Vienna (Austria)). May 1972. 55p. IAEA $3.00.

A summary of technology is presented on design of containers for wastes of various activity levels. Information is included on the nature of liquid radioactive wastes, design of waste storage tanks, design of storage tank accessories, tank operation, shielding considerations, safeguards, and cost. (J.R.D.)

43635 EFFECT OF THERMAL AND GRAVITATIONAL GRADIENTS ON THE MOVEMENT OF LIQUIDS AND GASES IN BEDDED SALT. Anthony, T. R.; Cline, H. E. (General Electric Research and Development Center, Schenectady, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 90-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43636 HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL BY TRANSMUTATION. Claiborne, H. C. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 91-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43637 FACT AND FICTION ABOUT WASTE DISPOSAL SYSTEMS. De Agazio, A. W. (NUS Corp., Rockville, Md.). Trans. Amer. Nucl. Soc.; 15: No. 1, 320(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43638 STORAGE EQUIPMENT FOR γ SOURCES. (to Ets Lemer and Cie). French Patent 2,070,277. 16 Aug 1971. Filed 6 Nov 1969. (In French).

This equipment, which is intended for storing γ emitters, consists of several separate sector-shaped storage elements (made of Pb) of curvilinear form. The center of curvature of these elements is also a pivoting axis, which facilitates their fitting into one another. The main advantage of the system is the pivoting system which enables a particular element to be displaced from the others, thus minimizing the dose received by the manipulator. (France)

Handling Equipment and Procedures

Refer also to abstracts 42844, 42849, and 43652.

43639 COMMENTS ON PAPER BY IRSHAD R. MUFTI, GEOTHERMAL ASPECTS OF RADIOACTIVE WASTE DISPOSAL INTO THE SUBSURFACE. Sullivan, Terence J.; Greer, Raymond T. (Iowa State Univ., Ames). J. Geophys. Res.; 77: No. 17, 3174-8 (10 Jun 1972).

Material presented by another author on the subject of the geothermal aspects of the subsurface disposal of radioactive wastes is examined, isotopic heat sources not considered in the original paper are noted and discussed, and suggestions are made for modifying the original heat flow calculations. (L.C.L.)

43640 ESTIMATION OF SPENT-FUEL TRANSPORTATION RISKS. Yadigaroglu, G.; Reinking, A. G.; Schrock, V. E. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 15: No. 1, 74-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43641 ELEMENTS OF A GOOD NUCLEAR CRITICALITY SAFETY PROGRAM. McLendon, J. D. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 302-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43642 COMPETENT NUCLEAR CRITICALITY SAFETY SPECIALIST IN INDUSTRY. Wilson, B. D. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 303-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43643 CONTINUING NEED FOR CRITICALITY DATA. Paxton, Hugh C. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 304-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43644 CRITICALITY SAFETY OF URANIUM METAL SCRAP IN CONCRETE BILLETS. Toffer, Hans; Weakley, Everett A. (Douglas United Nuclear, Inc., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 310-11(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43645 REMOTE HANDLING ARM. Blanchard, Paul; Foure, Andre; Gicquel, Pierre; Lardillon, Serge (to Commissariat a l'Energie Atomique). French Patent 2,085,185. 24 Dec 1971. Filed 9 Jan 1970. (In French).

An arm for the remote handling (from the outside) of radioactive objects inside a cell is described. The arm consists of a hollow rod fixed at one of its ends to a platform upon which a lever supporting a pivoting gripping device is mounted, and fixed at its other end to a nut and bolt system connected to a motor which axially displaces the arm. The hollow rod is also provided with a coaxial sheathing connected to another motor which controls the rotation of the arm. (France)

43646 EQUIPMENT FOR MICROWEIGHING INSIDE A SEALED ENCLOSURE. Guerin, Louis (to Commissariat a l'Energie Atomique). French Patent 2,077,948. 5 Nov 1971. Filed 6 Feb 1970. (In French).

Equipment enabling microweighings of dangerous or toxic substances, e.g., α emitters, inside a glove box, to be performed is presented. The base of the glove box rests on a first table. The bottom of this table is provided with openings, which correspond to those of a second table. In this way the two tables are connected together. The second table, which is totally independent of the first, is very rigid; it is this table that supports the balance. The gas-tightness of the glove box in the region of the opening is ensured by a thin supple sealing foil covering the second table and fixed to the edges of the opening. (France)

43647 DISPOSAL OF RADIOACTIVE WASTES. Gerard, Francis. Ind. At. Spatiales; 26: No. 1, 11-12(Jan 1972). (In French and English).

The most common method of disposing of radioactive waste is to enclose it in a stainless steel cask which is subsequently buried in the sea. The resistance of such casks to corrosion cannot be guaranteed for the coming hundreds or thousands of years. The Atomic Energy Commission has suggested that radioactive waste could be put into unused salt mines where it could be controlled at a minimum cost. (France)

43648 INSTALLATION FOR DRYING RADIOACTIVE SUBSTANCES. Arnal, Thierry; Ganivet, Michel; Somon, Roland (to Commissariat a l'Energie Atomique). French Patent 2,067,851. 26 Jul 1971. Filed 19 Nov 1969. (In French).

An installation for drying radioactive substances (in particular oxalate) in view of transforming them into dry oxide and then into appropriate fluoride for producing the metal is described. The installation consists of a device for handling the closed containers containing the substance to be dried and a drying oven; which are situated inside a sealed enclosure. The drying oven consists of a metallic sleeve joined to the wall of the enclosure and within which the containers are positioned by a remote control device, this sleeve being completed at the outside of the enclosure by an envelope containing the heating elements. The metallic sleeve is rigidly fixed to the wall of the enclosure by a sealed joint. A suction hood is provided to evacuate the gas released during the drying process. (France)

43649 DISTRIBUTION PUMP. Bost, Jose (to Commissariat a l'Energie Atomique). French Patent 2,080,245. 18 Oct 1971. Filed 27 Feb 1970. (In French).

A pump is described which enables flasks to be filled with given quantities of a liquid solution. The pump is particularly suitable for filling flasks with radioactive solutions for scintillation spectrometry. The pump is provided with two identical parallel syringes attached to a fixed support, each syringe containing a movable piston. A driving mechanism consisting of an electric motor (with two senses of rotation) driving in the opposite sense two parallel screws supported by the fixed support is also provided. Each screw is associated with a threaded device welded to one of the pistons, the devices being free to translate along the screw, but not free to rotate. A programming device determines the time when the operation of the motor is initiated, the time when the motor is stopped, the sense of the rotation, and the amplitude of the displacement of the threaded devices along the screws. An assembly which feeds the syringes with the liquid solution is provided with an elongated part which dips into the solution reservoir, and another elongated part situated opposite the first and joined to a distribution device common to both syringes. Each tube system incorporates two nonreturn clapper valves for the sucking up and expelling of the solution and an electrical circuit serving as a general control system. (France)

43650 CONTAINER FOR RADIOACTIVE GAS. Delfosse, Jean (to Commissariat a l'Energie Atomique). French Patent 2,080,192. 18 Oct 1971. Filed 26 Feb 1970. (In French).

A vessel for storing and transporting a radioactive gas (tritium), which avoids the risk of contaminating the gas and complies with the safety condition requirements, is presented. The vessel is reliable and possesses good leak-proof characteristics. The vessel is of cylindrical form and constructed of welded metallic sheet, the top and bottom parts possessing metallic ends pressed into the body of the vessel. The upper end, which is open, is provided with a welded flange; a sealed metallic joint is used to connect this flange to an angle valve incorporating a metallic clapper and blower. An orifice traversing the flange is used in connecting the valve to the body of the vessel. (France)

Transportation

Refer also to abstracts 43640 and 43644.

43651 (DPSPU--68-124-2(Suppl.1)) SAFETY SUMMARY REPORT: CURIUM SHIPPING CASK (PACKAGING OF RADIOACTIVE AND FISSILE MATERIALS). Final Report. Whatley, V. Jr. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). May 1972. Contract AT(07-2)-1. 13p. Dep. NTIS.

A supplement to the original report (DPSPU 68-124-2) issued April 1968 is presented which documents supporting information for previous revisions to DOT Special Permit No. 5738 to allow use of cask SP 5738 (the curium shipping cask) for shipping californium-252, and to allow shipment by common carrier. Supplemental information is also included to show that californium-252 shipments in the cask comply with IAEA Regulations for the Safe Transport of Radioactive Materials, 1967 edition. This information is provided as the basis for further revision of the Permit to allow overseas shipments of californium-252. (auth)

43652 SIMPLIFICATIONS USED FOR ROCKY FLATS DRUM AND SMALL PACKAGE COUNTERS. Harlan, R. A.; Lawless, J. L.; Chanda, R. N.; Deal, R. A. (Dow Chemical Co., Golden, Colo.). Trans. Amer. Nucl. Soc.; 15: No. 1, 83-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43653 DENSITY EFFECTS ON THE k_∞ OF SHIPPING PACKAGES. Artigas, Ricardo (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 311-12(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 42971.

43654 (CERN–1050) 300 GeV PROGRAMME. (European Organization for Nuclear Research, Geneva (Switzerland)). 14 Jan 1972. 236p. Dep. NTIS (U. S. Sales Only).

The machine lattice; injection system, magnet system; magnet power supplies; acceleration system; vacuum system; correction elements; control system; survey system; radiation protection system; extraction system; experimental areas; site; site installations and buildings; time schedules, manpower requirements, and cost estimates are discussed in detail. Also, the design parameters are listed. (W.H.K.)

43655 (RHEL/R–253) NIMROD OPERATION AND DEVELOPMENT. Quarterly Report, January 1–March 31, 1972. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Apr 1972. 12p. Dep. NTIS (U. S. Sales Only). UK 15 pence.

The Nimrod beam was on for High Energy Physics for 90.3% of HEP scheduled operating time. One experiment was completed, nine continued through, and two commenced in this quarter. Personal Dosimetry statistics for Nimrod Division for 1971 are presented. Some of the equipment relating to extraction systems installed in the December 1971/January 1972 shut-down is reviewed. (auth) (UK)

43656 ACCELERATORS IN MEDICINE. Almond, Peter R. (Univ. of Texas, Austin. Univ. of Texas, Houston). Trans. Amer. Nucl. Soc.; 15: No. 1, 176-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43657 ACCELERATORS IN RESEARCH. Knapp, E. A. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 177(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43658 USE OF ACCELERATORS IN NUCLEAR SAFEGUARDS. Umbarger, C. J. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 177-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43659 ACCELERATORS IN ENVIRONMENTAL ANALYSIS. Cahill, Thomas A. (Univ. of California, Davis). Trans. Amer. Nucl. Soc.; 15: No. 1, 178(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43660 RESONANT ACCELERATION OF PARTICLES BY FAST ELECTROMAGNETIC WAVES PROPAGATING PARALLEL TO AN INCREASING MAGNETIC FIELD. Didenko, A. N.; Kononov, V. K. This paper was summarized in At. Energ. (USSR); 30: No. 1, 50(Jan 1971) as paper No. 463/5773. (In Russian).

The possible continuous acceleration of charged particles in a smooth waveguide of rectangular or circular cross section along whose axis a TE_{n1} wave is propagating with a phase velocity $v_p = \beta_p c$ ($\beta_p > 1$) is studied. The waveguide is placed in an external axisymmetric magnetic field. If the magnetic field is constant along the length, the phase shift of the particle which arises with respect to the wave will lead to the disruption of self-resonant acceleration. For continuous acceleration of the particles, the magnetic field must change along the waveguide in a specific manner. In this case, the acceleration will not be self-resonant, so the trajectory of the equilibrium particle and the stability of the motion about this trajectory are studied. The equation of motion of a charged particle in the field of left-rotating travelling TE_{11}-wave is solved, and from the solutions, the required behavior of the external magnetic field along the waveguide axis is found. According to the calculations, parameters are selected such that the particle moves along a helix of constant radius and constant spacing over essentially the entire length of the acceleration. The stability of the motion is also treated in a linear approximation. Numerical calculations show that such accelerators may be useful for producing highly intense beams of electrons with energies of the order of several (or tens of) megaelectron volts. (W.H.K.)

43661 EUROPEAN PARTICLE PHYSICS AT GENEVA. Shaw, E. N.; Southworth, B. (CERN, Geneva). Nature (London); 237: No. 5352, 212-14(26 May 1972).

The high-energy physics activities of the European countries at Geneva are outlined including construction of the super proton synchrotron, operation of the Intersecting Storage Rings, collaboration with the Institute of High Energy Physics at Serpukhov; and work with high energy physics laboratories of the U. S. Budgeting and operation of the CERN laboratory I are also discussed. (W.H.K.)

43662 HIGH-ENERGY ACCELERATORS FOR HEAVY IONS. van Nieuwland, J. M. (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Ned. Tijdschr. Natuurk.; 37: 91-9(18 Mar 1971). (In Dutch).

A survey is given of accelerators for heavy ions with a final energy of 7 MeV per nucleon or more. The requirements for the accelerators are described without giving constructional details. It is shown that high energies of heavy ions can only be achieved with two-stage accelerators having electron-stripping between the two stages. Various combinations of linear and circular accelerators are discussed, and it is concluded that the present state of accelerator technique does not offer a unique solution for specific requirements. (Netherlands)

Auxiliaries and Components

Refer also to abstract 43948.

43663 (IFVE-ORE–71-84) ON RADIATION PASSING THROUGH THE LABYRINTH OF THE IHEP 70 GeV SYNCHROTRON. Borodin, V. E.; Obryashikova, L. P.; Chimankov, M. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

The radiation field distribution in two typical multichannel labyrinths of different cross-sections and shape passing through the biological shielding of the 70 GeV synchrotron and used for technological purposes were studied, and the results are given. (auth)

43664 COMPACT FARADAY CUP ARRAY FOR MEASUREMENT OF CURRENT DISTRIBUTION FROM PULSED ELECTRON BEAMS. Schuch, Robert L.; Kelly, John G. (Sandia Labs., Albuquerque, N. Mex.). Rev. Sci. Instrum.; 43: No. 8, 1097-9(Aug 1972).

Thirteen Faraday cups were fitted into a common housing to measure current distribution as a function of time, position, and drift tube pressures of the electron beam emitted by the 45 kA electron beam accelerator at the Sandia Laboratories. Description of the instrument design and the electronic configurations are given along with some examples of signals generated in individual cups by short duration (~100 nsec) pulses of 3.2 MeV electrons. (auth)

43665 ASTRON ON-LINE BEAM ENERGY ANALYZER. Fessenden, Thomas J. (Univ. of California, Livermore). Rev. Sci. Instrum.; 43: No. 8, 1090-3(Aug 1972).

An analyzing system based on an in-beam tungsten wire scatterer that was developed to measure the energy of a high-current, short-pulse electron beam of a few MeV energy produced by a linear accelerator is described. The system is able to determine the absolute energy of the beam with an accuracy of approximately 2%. It may also be used to determine variation of the beam energy of less than 0.1% occurring in times less than 10 nsec. Measurements of the beam current averaged over a pulse as a function of energy may also be made. Since the system uses a very small fraction of the primary beam current, it causes no interference with the normal operation of the accelerator. (auth)

43666 MEASUREMENT OF BEAM PARAMETERS FOR α-PARTICLES EXTRACTED FROM THE JINR HEAVY-ION 2 METER ISOCHRONOUS CYCLOTRON. Alfeev, V. S.; Vorob'ev, E. D.; Zorin, G. N.; Kharitonov, Yu. P. This paper was summarized in At. Energ. (USSR); 31: No. 2, 140-1(Aug 1971) as paper No. 521/6078. (In Russian).

Full copy of this paper is held by TIC.

The energy of α-particles was measured using Rutherford scattering on a thin gold foil (0.25 μ) at an angle of 20° l.s. (laboratory system), since in this region of angles for the ^{197}Au (α,α) reaction channel, the cross section of elastic scattering of α-particles in the energy range of 30 to 40 MeV exceeds the cross sections of inelastic processes by several orders of magnitude. The beam, with a geometric radius of 860 mm, was extracted from the JINR U-200 cyclotron using a charge-exchange technique. To detect the α-particles a semiconductor surface barrier detector with a 27 mm^2 cross section was used which is made from high resistivity silicon. The detector was situated at a 45° angle l.s. relative to the scattered beam, and at a bias of 300 V provided a sensitive layer of ~800 μ, corresponding to the mean free path of α-particles with an energy of ~45 MeV. After the removal of the spectrum of scattered α-particles, the scale of the 1024 channel analyzer was determined by a precision pulse generator which was calibrated at the known α-lines from ^{212}Po (8.776 MeV) and ^{216}Po (6.774 MeV). The measured energy of α-particles extracted from the U-200 is equal to 36.5 ± 1.0 MeV, and the degree of monochromatism of the α-beam, allowing for the inherent resolution of this procedure, is equal to 350 ± 50 keV, which is 1% of the beam energy. It has been established that one of the basic contributions to resolution is the instability of the high-frequency voltage on the dees of the cyclotron. As a check on the measurements, a stack of aluminum foils with a common density of 100 ± 4 mg/cm^2 was introduced. The thickness of each foil was 6 μ. The energy of the α-particles after the absorber was equal to 17.5 MeV, which corresponds to an energy of primary α-particles of 36.0 ± 1.4 MeV. The energy measurement by means of absorbers agrees well within the limits of error with the measurements by the precision pulse generator. (auth)

43667 USE OF HIGH-VOLTAGE ALTERNATING CURRENT FOR INDUSTRIAL RADIATION PROCESSES. **Chepel, L. V. This paper was summarized in At. Energ. (USSR); 30: No. 5, 448(May 1971) as paper No. 489/5901. (In Russian).**

Full copy of this paper is held by TIC.

The possibility of using a high voltage alternating current to feed the accelerator tubes of industrial radiation equipment is considered. Realization of this possibility in the 300 to 750 keV energy range will simplify the construction of accelerator equipment to a considerable extent and increase reliability through the use of either high voltage power supplies containing no rectifiers or condensers, or electrical transmission lines at a corresponding voltage. The advantages of using an electron beam with a sinusoidal energy spectrum are evaluated analytically. The corresponding integral curves are obtained by approximating the distribution curve of the deep dose by a sine wave segment. From these curves the energy efficiency of the electron beam and the degree of depth nonuniformity of the dose in the material were determined for irradiation from two sides. The method of sweeping the sinusoidal-spectrum electron beam by modulating the deviating magnetic field is proposed. The shape of the modulating magnetic field sweep curve and the relationship of its frequency to the electron kinetic energy were found. (W.H.K.)

43668 DISCRETE SYSTEMS FOR DAMPING OUT BETATRON OSCILLATIONS. **Roginskii, L. A.; Yudin, L. A. This paper was summarized in At. Energ. (USSR); 30: No. 3, 300 (Mar 1971) as paper No. 472/5778. (In Russian).**

The construction of a general theory of discrete automatic correction systems for automatic correction of betatron oscillations in high-energy accelerators is discussed. The system is approached with either transverse or longitudinal pushers for arbitrary amplitude-phase characteristics of the feedback circuits. (W.H.K.)

43669 SEALED CONNECTING DEVICE FOR ELECTRON ACCELERATOR. **Dedieu, Paul (to Compagnie Generale d'Automatisme). French Patent 2,082,415. 15 Nov 1971. Filed 13 Mar 1970. (In French).**

A device forming a sealed joint between a linear electron accelerator and a vessel containing this accelerator is presented. The device can be used over a wide range of conditions and possesses great flexibility. (France)

43670 SURFACE-BARRIER BEAM MONITOR. **Lakin, W. L. (Stanford Univ., Calif.). Nucl. Instrum. Methods; 102: No. 2, 367-9(1972).**

A thin silicon surface-barrier semiconductor detector was used to monitor the intensity of a pulsed high-energy electron beam of between 10^2 and 10^6 electrons per 1.6 μs pulse. (auth)

Ion Sources, Injection, and Extraction

43671 (JINR-P16-6433) EXPERIMENTAL INVESTIGATION OF SPACE-ENERGETIC DISTRIBUTION OF PROTON LOSSES AT THE JINR SYNCHROPHASOTRON. **Gvozdev, V. Ya.; Zaitsev, L. N.; Kolpakov, I. F.; Kryachko, A. P.; Nikityuk, N. M.; Pavlov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).**

It is shown that for determination of the accelerator radiation field at the effective extraction of the beam, it is necessary to know azimuthal distribution losses of protons per acceleration cycle at the moment of ejection. The detection system of particle losses at the 10 GeV synchrophasotron of JINR is described. The system consists of 20 scintillation counter scalers and controllers. The counters, located near the vacuum chamber ring, are used for counting secondary protons and pions. For calculation of primary proton losses, the corresponding calibration procedure is applied. The accuracy of measurements is about 20%. (auth)

43672 IMPEDANCE AND SPOT-SIZE MEASUREMENTS ON AN INTENSE RELATIVISTIC-ELECTRON-BEAM DEVICE. Condit, W. C. Jr. (Univ. of California, Livermore); Pellinen, D. Phys. Rev. Lett.; 29: No. 5, 263-5(31 Jul 1972).

Voltage, current, and x-ray measurements were made on a 700-keV, 50-kA electron-beam generator using a small dielectric rod cathode. The beam is very tightly pinched, and current densities exceeding previously published values are verified. (auth)

Ion Optics and Field Calculations

43673 (BNL-16945) BEAM BUNCHING IN THE AGS THROUGH THE USE OF PULSE EXCITED ACCELERATING CAVITIES. **Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 9 Jun 1972. 10p. Dep. NTIS.**

A beam bunching method for bunching the AGS beam for injection into ISABELLE is described. The steps in the process include 1) adiabatically reduce the rf accelerating voltage from 400 to 10 kV; 2) turn on and capture the beam in a pulse excited resonant cavity tuned to 35.6 MHz; 3) decrease the time interval between pulses in a carefully programmed manner; and 4) reenergize the sine wave rf system at 2.59 MHz with 4 kV crest voltage, and then raise the rf voltage adiabatically, compressing the total time width of the beam bunch by a factor of 2.5. (W.H.K.)

43674 (NP-19359) PECULIARITIES OF FORMATION OF MAGNETIC FIELDS, SIMILAR IN A BROAD RANGE OF INDUCTIONS. **Preprint B-0136. Borisov, V. D.; Vaulin, L. N.; Doinnkov, N. I.; Petrov, V. A.; Simakov, A. S.; Sudarushkin, A. S. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1971. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).**

A study was conducted on different methods for shaping a uniform field in electromagnets with a constant effective length in a wide range in an operating region. The case of an asymmetric magnet yoke is considered. The analysis of magnetic characteristics and methods of their correction is made on an experimental model. The program was worked out and calculations for end fields were made under the assumption $\mu = \infty$. (auth)

43675 (SGAE-2007) ELECTRA: A COMPUTER PROGRAM FOR CALCULATION OF SPACE-CHARGE-FREE PARAXIAL TRAJECTORIES IN AXIALLY SYMMETRIC ELECTROSTATIC FIELDS. **Meier, H.; Pissenberger, S.; Ruedenauer, F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). Mar 1972. 17p. (In German). $_{23}$(PH-115/72). Dep. NTIS (U. S. Sales Only).**

A description and a user's manual for the computer program "Electra" are presented. The program computes paraxial trajectories in axially symmetric electrostatic fields not taking into account space charge effects. Values of the electrostatic potential have to be known in discrete points along the axis of symmetry. Trajectories in an electron gun are computed as a program test. (auth)

43676 PULSE SHORTENING EFFECT IN AN ELECTRON MICROTRON. **Lakovichev, E. F. This paper was summarized in At. Energ. (USSR); 31: No. 3, 272(Sep 1971) as paper No. 527/5939. (In Russian).**

Full copy of this paper is held by TIC.

The beam breakup phenomenon due to transverse beam instability has acquired the name of pulse shortening effect. The broadening of the beam in the accelerating structure of an electron microtron, attributed to the interaction between the electrons and the field of hybrid waves excited in the structure by the electron beam itself, is studied. Expressions for the amplitude of the radial deflection of bunches corresponding to each orbit number are given. The results obtained show that the development of transverse beam instability in the accelerating structure of the electron microtron has the same dependence on the current, length of the structure, and duration of the injection pulse as that found in linear accelerators. But treatment of electron energies of different magnitude and characteristic of each orbit is important here; the limiting value of the circulating current in an electron microtron may be several times greater than the corresponding current in a linear accelerator (all other conditions being equal). The results cited can be used for a qualitative estimate of transverse beam instability in the accelerating structure of an electron microtron, and also to determine the "critical" current values and the duration of the injection pulse. (auth)

43677 MIRROR CAPTURE OF A HIGH-CURRENT SELF-FOCUSSING RELATIVISTIC ELECTRON BEAM ON A CLOSED ORBIT. Khodataev, K. V. At. Energ. (USSR); 32: No. 5, 379-82(May 1972). (In Russian).

Certain properties of self-focusing beams which have been noted in various experiments, in particular their ability to be "reflected" from conducting surfaces, are discussed. On the basis of developed elementary theory, self-focusing beam capture on a circular orbit is considered. It is estimated that electron rings having small dimensions and containing 10^{15} to 10^{16} electrons may be obtained. (2 figures, 1 table, 11 references.) (auth)

43678 INSTABILITY OF A RELATIVISTIC BEAM IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Demutskii, V. P.; Polovin, R. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 8, 1379-80(Aug 1971). (In Russian).

Instability of an electron beam in a medium results when the beam velocity exceeds the velocity of electromagnetic waves in that medium. The theoretical development seeks the modification of this result in the relativistic case, in which a relativistic electron beam is propagated through crossed electric and magnetic fields in a retarding medium. Calculations with relativistic electrons did not alter the original conditions of instability. (K.S.W.)

Storage Rings

Refer also to asbtracts 43673 and 43964.

43679 (BNL-16976) DEUTERONS FOR ISABELLE. Sluyters, Th. J. M. (Brookhaven National Lab., Upton, N. Y.). 23 Jun 1972. 7p. Dep. NTIS.

The acceleration of deuterons in the AGS for injection into ISABELLE is considered. Limitations of deuteron acceleration in the linac injector, transfer lines, and the synchrotron are discussed. It is concluded that the AGS can inject into ISABELLE as much as 10^{12} deuterons per pulse at 32 GeV/c. (W.H.K.)

43680 (LNF-71/90) STUDY OF A MAGNETIC DEVICE WITH LONGITUDINAL FIELD FOR EXPERIMENTATION WITH ADONE. Bartoli, B.; Bisello, D.; Cattoni, A.; (and others) (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 20 Dec 1971. 17p. (In Italian). Dep. NTIS (U. S. Sales Only).

An analysis of the magnetic device for experimentation with Adone (MEA) showed that, for a relatively modest cost, it was possible to construct a second magnet, longitudinal, served by the same general installation as the MEA and operating in alternation. The design of this magnetic longitudinal analyzer (MLA) is described. The MLA is compared with the MEA. Reasons for the construction of an apparatus of the MLA type are discussed, and its cost is approximated. (10 figures, 7 tables) (J.S.R.)

Experimental Facilities

Refer also to abstract 44493.

43681 (JINR-P13-6324) APPARATUS FOR PRODUCING JET TARGETS FROM CONDENSED HYDROGEN WHILE OPERATING ON THE INTERNAL BEAM OF AN ACCELERATOR. Bartenev, V. D.; Belushkina, A. A.; Valevich, A. I.; Gai, G. I.; Gorelov, A. M.; Ershov, V. P.; Kotova, L. S.; Nikitin, V. A.; Pilipenko, Yu. K.; Smelyanskii, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The construction of an apparatus for producing jet targets operating on the internal beam of an accelerator was developed. The target used jets of condensed hydrogen having the following parameters: diameter-10 mm, duration-about 300 msec, and approximate density-10^{-6} g/cm^3. The processes of hydrogen condensation and the alteration of the vacuum with time of existence of the jet were examined and investigated. (tr-auth)

43682 (LA-4863) LASL INTENSE 14-MeV NEUTRON SOURCE. Henderson, Dale B. (Los Alamos Scientific Lab., N. Mex.). Jun 1972. Contract W-7405-eng-36. 10p. Dep. NTIS.

At least two independent suggestions have been made to build a 14-MeV neutron source at 10^{14} to 10^{15} neutrons/cm^2-sec for materials damage studies related to fusion power reactors. The neutron source utilizes a Cockcroft-Walton accelerator and a windowless gas target for tritium (d,n) neutron production. A feasibility study is proposed in which such a 14 MeV source would be thoroughly investigated. (auth)

43683 (ORNL-TM-3397) SELF-REPLENISHING TRITIUM TARGET FOR NEUTRON GENERATORS. Haywood, F. F.; Burson, Z. G.; Banta, H. E. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 47p. Dep. NTIS.

The pressing need for 14-MeV neutron generators which produce high neutron yields for long periods of time motivated a search for better methods of target preparation. The neutron yield from two reactions (T[d,n]^{4}He and D[d,n]^{3}He) under a variety of conditions was studied. A new concept in target design was investigated. It uses the principle of self-replenishment with tritium through a silver-palladium membrane. Three targets of this type were tested; the third producing a high and sustained yield of 14-MeV neutrons. The yield surpassed the best "standard" target tested after only 16 minutes of operation. It was run for a period slightly less than ten hours with a yield generally above 2×10^{10} neutrons/sec (one mA/cm^2 @ 185 kV). The silver palladium, self-replenishing target principle offers the most potential of obtaining high yields with long half-lives. Indeed, the third prototype tested in this series of measurements could be used immediately in small machines using beam currents on the order of one milliampere. More research and development is required to maximize available parameters and to see if high-beam densities in small targets will also be successful. (W.H.K.)

43684 BLIP BROOKHAVEN LINAC ISOTOPE PRODUCER: A NEW CONCEPT IN RADIONUCLIDE PRODUCTION. Richards, P.; Lebowitz, E. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 133(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43685 SELF-REPLENISHING TRITIUM TARGET. Jobst, J. E. (EG and G, Las Vegas, Nev.); Burson, Z. G.; Haywood, F. F. Trans. Amer. Nucl. Soc.; 15: No. 1, 155-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43686 MULTIPURPOSE INDUSTRIAL IRRADIATION FACILITY. Gignoux, Dominique (Columbia Research Corp., Gaithersburg, Md.). Trans. Amer. Nucl. Soc.; 15: No. 1, 168-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43687 ON-LINE DATA-ACQUISITION PROGRAM FOR NUCLEAR-PHYSICS EXPERIMENTS ON THE ARGONNE TANDEM. Tippie, J. W. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 645-50 (Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A general-purpose program for data acquisition and control of nuclear physics experiments is described. Particular emphasis is given the problems of flexibility and ease of operation, as well as techniques dealing with experimenter-computer interaction. Various graphical techniques for one- and two-dimensional data presentation are discussed. (7 figures, 1 table) (auth)

43688 ARIEL: ON-LINE EXPERIMENTAL DATA ACQUISITION AND REDUCTION. Brun, J. C.; Picard, F.; Sellem, R.; Verroust, G. (Univ. Paris, Orsay, France). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 654-62(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

ARIEL is a collective system conceived in an Institute having 3 particle accelerators and a Nuclear Spectrometry center, in order to allow several research teams to incorporate a powerful computer into their experimental equipment. ARIEL, uses an IBM 360/50 to handle simultaneously 4 remote, independent, on-line experiments. The machine runs in a multiprogramming mode under an operating system IBM OS 360 MFT modified to do several real-time jobs simultaneously. Specially designed units were connected to the computer for implementing data acquisition, graphic and literal dialogue with the experimenter, and the data reduction and editing of the results. A large software using supervisor extensions enables the scientist a simple FORTRAN use of all these units, from the preparation of the experiment to the editing of the final results. ARIEL was designed in 1965, from the experience gained by several years use of a first collective system (1961). About a hundred different experiments performed on ARIEL since 1968 showed the value of the choices made. (5 figures) (auth)

43689 YALE-NAL CAMAC SYSTEM. Dhawan, Satish (Yale Univ., New Haven). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 689-95(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The details of a CAMAC system for a high energy physics experiment are described. This is a multicrate system using a type A crate controller and branch highway, which has been in physics use since January, 1971. The branch driver and most of the modules are commercially available. (10 figures) (auth)

43690 DESIGN OF AN N-GAP BUNCHER FOR VELOCITY MODULATION. Noblet, A. (Univ. Libre, Brussels). Nucl. Instrum. Methods; 102: No. 2, 245-51(1972). (In French).

When a buncher is used in order to get rather narrow target pulses of charged particles, it is usually necessary to utilize a multiple-gap buncher. In order to be able to design an n-gap buncher we have established the theoretical expressions giving the parameters of such a buncher. These parameters, i.e. optimum bunching length, input phase of central ion and bunching ratio, suffice to determine entirely the buncher. The expressions remain valid within sufficient limits so as to cover a wide application range. A buncher for 250-keV deuterons for a pulsed neutron source is briefly discussed. (auth)

43691 MEASUREMENTS OF INHOMOGENEITIES OF MAGNETIC FIELDS IN A MODEL BEAM-ANALYZING MAGNET. Okuma, Y. (Osaka Univ.); Yagi, K.; Kumabe, I.; Matsuda, K. Nucl. Instrum. Methods; 102: No. 2, 317-25(1972).

A sectorial model beam analyzing magnet has been fabricated to obtain some precise information about the inhomogeneities of magnetic fields for an ordinary magnet. The magnet has field homogenizers, air gap spacers machined accurately, pole pieces separated from the yokes and a power supply with a current-stability better than 1 part in 10^4. In the magnet constructed so as to suppress mechanical aberrations, the important sources producing the field inhomogeneities in an azimuthal direction are the saturation effect in the pole piece iron, the mechanical accuracy of the pole pieces, the setting procedure of the field, the type and iron material of the pole pieces, and so on. The field inhomogeneities in a radial direction arise mainly from the difference of the leakage factor in the pole piece sides at small and large radii, and the narrowness of the effective pole piece width. Field homogeneities are not improved by introducing the field homogenizers. The B-constant design of the pole pieces has excellent effects on the field homogeneity. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 42832, 43782, 44466, and 44516.

43692 (JINR–P7-6495) ON THE ORIGIN OF TRACKS OF FISSION FRAGMENTS IN LEAD GLASSES. Flerov, G. N.; Perelygin, V. P.; Otgonsuren, O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The origin of the tracks of fission fragments, observed when etching old lead glasses, is studied. Using track coincidence in two layers of polymeric film, it is shown that this effect is apparently due to the fission of lead nuclei induced by the nucleon component of cosmic radiation. The probability of lead fission due to the nucleon component is found to be (15 ± 4) fissions/gram per year. (auth)

43693 (N–72-18815) EFFECTS OF PROPAGATION AND SOURCE DISTRIBUTION ON COSMIC-RAY COMPOSITION AND ANISOTROPY. Ramaty, R.; Lingenfelter, R. E. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1971. 30p. (NASA-TM-X-67538). NTIS.

The propagation and source distribution of cosmic rays are considered. The principal requirement for the various models is that they should be capable of holding particles in dense regions of the galactic disk for time periods sufficient to produce the observed fragmentation products of cosmic rays. This can be achieved by both simple and compound diffusion provided that suitable mean free paths and boundary conditions are chosen. The bulk of the anisotropy is caused by the discrete nature of the cosmic-ray sources. Models which reproduce the fragmentation products yield anisotropies consistent with available upper limits. (auth) (STAR)

43694 (N–72-18816) INTERPLANETARY DECELERATION AND THE SIGNIFICANCE OF THE OBSERVED COSMIC-RAY DEUTERON AND ^{3}He FLUXES. Meyer, Jean-Paul (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug 1971. 11p. NTIS.

The cosmic-ray low-energy deuteron and helium-3 formation mechanisms and propagation in the interstellar space are discussed. The adiabatic deceleration in the solar cavity due to the solar-activity effects is explained. (STAR)

43695 NUCLEAR TRACK STUDIES IN EXTRATERRESTRIAL MATERIALS. Walker, R. M. (Washington Univ., St. Louis). Trans. Amer. Nucl. Soc.; 15: No. 1, 115(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43696 TRACK ANALYSES AND URANIUM CONTENTS OF APOLLO-14 GLASSES. Storzer, D.; Wagner, G. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Trans. Amer. Nucl. Soc.; 15: No. 1, 119-20(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43697 ORBITAL OBSERVATIONS FROM APOLLO 15. Trans. Amer. Nucl. Soc.; 15: No. 1, 136(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43698 NASA'S LUNAR SAMPLE ANALYSIS PROGRAM. Pomeroy, John (National Aeronautics and Space Administration, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 137 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43699 RADIOACTIVITY OF LUNAR SAMPLES: APPLICATIONS TO STUDIES OF COSMIC-RAY FLUXES, LUNAR SURFACE PROCESSES, AND PRIMORDIAL RADIO-ELEMENT DISTRIBUTION. O'Kelley, G. Davis (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 137(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43700 CHEMICAL COMPOSITION OF THE MOON. Schmitt, Roman A. (Oregon State Univ., Corvallis). Trans. Amer. Nucl. Soc.; 15: No. 1, 137-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43701 FRACTIONATED TRACE ELEMENTS IN LUNAR ROCKS AND SOILS. Reed, George W. Jr. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 139(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43702 NEUTRON REACTION CROSS SECTIONS OF IRON AT 14.5 MeV. Singh, Jag J. (Langley Research Center, Hampton, Va.). Trans. Amer. Nucl. Soc.; 15: No. 1, 147-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43703 ^{222}Rn ACTIVITY AT OCEANUS PROCELLARUM. Brodzinski, R. L. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 148(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43704 DEPTH-DOSE DISTRIBUTIONS IN A TISSUE PHANTOM SHIELDED FROM GALACTIC COSMIC-RAY PROTONS. Santoro, R. T.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 557-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43705 CALCULATION OF THE NEUTRON SPECTRUM IN THE EARTH'S ATMOSPHERE PRODUCED BY GALACTIC COSMIC RAYS. Armstrong, T. W.; Chandler, K. C.; Barish, J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 562-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43706 RELATIVE ABUNDANCE OF ELEMENTS IN COSMIC RADIATION. Wataghin, G. (Univ., Turin). pp 243-5 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The problem of the origin and distribution of chemical elements in the Universe and the related question of the relative abundance of nuclei in primary cosmic radiation are discussed briefly. Special consideration is given to the recent finding of heavy transuranic elements in cosmic radiation of galactic origin. It is suggested that the most plausible origin of these transuranic nuclei can be sought in the pulsars. (A.G.W.)

43707 NIOBIUM IN METEORITES. Graham, A. L.; Mason, Brian (Smithsonian Institution, Washington, D. C.). Geochim. Cosmochim. Acta; 36: No. 8, 917-22(Aug 1972).

Spark-source mass-spectrographic analyses of six chondrites and six achondrites for niobium are reported. The geochemical behavior of niobium shows a relative coherence between the Ta, Ti, and Zr contents of meteorites and lunar samples and a lack of correlation with Ca and Al. The data provide a more substantial basis for the chondritic niobium abundance, which is estimated to be 0.5 ppm, equivalent to 0.9 atoms/10^{6} atoms Si. (auth)

43708 BISMUTH IN STONY METEORITES AND STANDARD ROCKS. Santoliquido, P. M.; Ehmann, W. D. (Univ. of Kentucky, Lexington). Geochim. Cosmochim. Acta; 36: No. 8, 897-902 (Aug 1972).

Bismuth was determined by alpha counting of the ^{210}Po daughter activity of the ^{210}Bi formed by thermal neutron activation. Results are presented for thirty chondrites, six achondrites, eight separated meteoritic phases, and six U. S. Geological Survey standard rocks. There is no resolvable difference in Bi abundances among the different groups of ordinary chondrites. Bismuth concentration decreases with increasing petrologic grade among the ordinary chondrites. The enstatite chondrites are separable into two groups on the basis of Bi data. (auth)

43709 PHYSICS OF COSMIC X-RAY, γ-RAY, AND PARTICLE SOURCES. Greisen, Kenneth. Topics in Astrophysics and Space Physics. New York; Gordon and Breach, Science Publishers, Inc. (1971). 122p. $9.95.

Topics covered include sources of high-energy particles, energetic solar particles, discrete sources remote from the Sun, interactions in the interstellar medium, origin of the primary electrons, cosmic gamma rays, and cosmic x-rays. (W.D.M.)

43710 α RADIOACTIVITY AND URANIUM AND THORIUM CONTENTS OF SIX LUNAR SAMPLES: AGE OF A SAMPLE OF

A LUNAR SOIL (APOLLO XI). Coppens, R.; Kosztolanyi, Ch. (Univ., Nancy). Ann. Soc. Geol. Belg.; 94: No. 2, 109-11(1971). (CONF-710953-3).

From European conference of geochronology; Brussels, Belgium (6 Sep 1971).

The α radioactivity and the uranium and thorium contents of four rock samples and two moon-soil samples were determined by α autoradiography using Ilford K2, 50-μ nuclear plates. The observations of the developed emulsions were done with a high-power microscope in order to adjust only on the emulsion surface. To eliminate the parasite traces coming from the radioactivity of the glass support and of the gelatin, spotless plates were developed and the traces examined in the same conditions. A background was calculated which was taken into account afterwards. The ratio Th/U was estimated by measuring the number ν_1 of α rays having in air a length superior to 7 cm (ThC′) and the number ν_2 of rays having in air a length comprised between 5, 8, and 7 cm (ThC′ partially absorbed + Ra C′ or AcA). (auth) (Belgium)

Stars

43711 (N–72–17910) STUDY OF B6 STARS. Underhill, Anne B. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jan 1972. 59p. (NASA-TM-X–65823; X–670–72–26). NTIS.

A study of the spectra of zeta Draconis (B6 III), beta Sextantis (B6 V), and alpha Leonis (B7 V), was made from high-dispersion spectrograms that cover the spectral region 3100 to 6700 A and from OAO 2 spectral scans covering the spectral region 1100 to 3600 A. Profiles, equivalent widths, and central intensities of many lines in the spectrum of zeta Draconis are presented, as well as for the major lines of beta Sextantis. Alpha Leonis rotates too rapidly for these measurements to be made from high-resolution spectrograms. Flux envelopes for zeta Draconis and alpha Leonis, from 1100 to 6050 A, were derived from published spectrum scans and from new scans obtained with OAO 2. Estimates of the radii and masses of these single stars are presented. (auth) (STAR)

43712 (N–72–19864) UV AND RADIOFREQUENCY OBSERVATIONS OF WOLF–RAYET STARS. Johnson, Hugh M. (Lockheed Missiles and Space Co., Palo Alto, Calif.). 1971. Contract NASw–1977. 21p. (NASA-CR–125691). NTIS.

Observations of W stars in the ultraviolet by OAO 2 and at 750 and 1400 MHz with the Green Bank telescopes are discussed. The emphasis is on the Green Bank observations of W stars with symmetric nebulae around them, their interpretation, and comparisons with other data. The implications regarding mass distribution, internal motion, flux density, ejected mass, velocity dispersion, and expanding envelopes are considered in detail. (STAR)

43713 (N–72–19865) UV SPECTRUM OF THE CRAB NEBULA. Johnson, Hugh M. (Lockheed Missiles and Space Co., Palo Alto, Calif.). 1971. Contract NASw-1977. 10p. (CONF-710842–1; NASA-CR–125692). NTIS.

From Symposium on scientific results from OAO-2; Amherst, MA. (23 Aug 1971).

Observations of the Crab Nebula are described, which were made under the OAO 2/NASA guest-investigator program with WEP stellar photometers. The 10-foot-diameter focal plane diaphragm was ample enough to accept the 4 ft × 6 ft image. The logarithm of the integrated relative intensity per wavelength interval, corrected for sky background, and the rms error, from 11 passbands in the range 4250 to 1380 A, are given. No correction was given for polarization of light. The data were converted to logarithm of the flux density per frequency interval and plotted on scales of log nu (Hz) and of reciprocal microns with two adjustments. (auth) (STAR)

43714 ROTATING NEUTRON STARS. Papoyan, V. V.; Sedrakyan, D. M.; Chubaryan, E. V. (Erevan State Univ.). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 950-4(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1195-1200(Nov 1971).

The structure and integrated parameters of pseudospheroidal equilibrium neutron-star models rotating at the uniform angular velocity ω were determined in the Newtonian approximation. The calculations were carried to ω^4 accuracy. The results differed insignificantly from the ω^2 approximation; thus for configurations in a critical state relative to equatorial instability the ω^2 approximation was entirely satisfactory. (auth)

43715 NARROW-BAND PHOTOELECTRIC PHOTOMETRY OF THE PECULIAR WOLF– RAYET ECLIPSING BINARY CV SERPENTIS. Cherepashchuk, A. M. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 955-63(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1201-11(Nov 1971).

CV Serpentis is shown to be an eclipsing variable in the λ 4653 Å emission feature of the spectrum, despite an insignificant ($\approx$0.04 to 0.05 m) brightness variation in u, b, v filters and in the continuum at λ 4795. Primary and secondary minima have depths of $\approx$0.19 m and 0.04 m; the elements are: Min hel = JD 2,440,013 + 29.719 d ($\pm$0.01 d) · E. The λ 4653 emission intensity drops by 34% at primary and 7% at secondary minimum. The Hjellming–Hiltner effect (in August 1962 the depth of eclipse increased to $\approx$0.5 m in the b, v bands) did not recur during six years of observation of CV Ser. The effect is known to have arisen from an eclipse of the WR star by its B0 V companion, not from an atmospheric eclipse. Evidently there is hardly an eclipse of the "core" of the WR component because the orbit plane is highly inclined to the line of sight. The absorption coefficient, surface brightness, and corresponding characteristic size of the WR envelope are greater in the 4653 region than in the continuum, so that an eclipse is observed (a "selective" atmospheric eclipse at primary minimum). The formation region of the 4653 emission feature fills the inner Roche surface, and may evidently be regarded as a quasispherical layer with maximum opacity per unit volume near the Roche limit. (auth)

43716 INFRARED RADIATION OF PLANETARY NEBULAE. I. OBSERVATIONS AT 1.0 TO 2.5 μ AND THE CONTINUOUS SPECTRUM. Khromov, G. S.; Moroz, V. I. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 892-900(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1122-33(Nov 1971).

Sixteen planetary nebulae were observed in the wavelength range 1.0 to 2.5 μ. These results were combined with other data to establish complete continuous spectra for nine of the planetaries. A comparison of the observed continua with those calculated from the standard theory of thermal emission showed that the observed radio, near-infrared (2.5–1.0 μ), and near-ultraviolet continuum intensities can be satisfactorily fitted by the theoretical spectrum, apart from the presence in some nebulae of excess radiation near 10 μ. Several theoretical expressions, tables, and a graph to facilitate calculating the spectra of gaseous nebulae are given in an Appendix. (auth)

43717 ORIGIN OF COMETARY NEBULAE AND GLOBULES AND THEIR ASSOCIATED STARS. Dibai, E. A. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 901-9(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1134-44(Nov 1971).

The internal motions in diffuse nebulae responsible for the origin of cometary nebulae and globules are discussed. It is suggested that the elongated "elephant trunk" structures are formed inside H I zones when local condensations (globules) move toward the center of gravity of a large nebula with a frozen-in magnetic field. From a hydrodynamical standpoint this process corresponds to a magnetogravitational Rayleigh–Taylor instability. The same mechanism would serve to engender globules through the accumulation of material in "magnetic funnels." An elephant-trunk structure would become a cometary nebula if a young star were to condense at the tip of the cone, where the gas density is highest. Other configurations are possible if the gravitational and magnetic fields have different geometries. Thus, contraction toward the galactic plane would yield biconical nebulae, while if the rotational velocity increases during the contraction process, spiral-shaped nebulae and comma-like objects would arise. Globules with H II zones would be compressed by convergent shock waves generated at the neutral-ionized hydrogen interface. Cumulative jets are possible in the event of a strong shock. The formative processes for the structural features of diffuse nebulae discussed here involve the condensation of diffuse matter. The two classes of hydrodynamic motion, subsonic in H I zones and supersonic in H II zones, correspond to two processes that promote star formation: equilibrium contraction and shock compression of the gas. (auth)

43718 OBSERVATIONS OF A FILAMENTARY NEBULA FORMED BY A SUPERNOVA OUTBURST IN MONOCEROS. Lozinskaya, T. A. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 910-14(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1145-9(Nov 1971).

Extensive observations were made of a faint filamentary nebula in Monoceros, using a Fabry–Pérot interferometer and a contact electronic image converter. The mean radial velocity of the nebula relative to the local standard of rest was +12 ± 5 km/sec. The nebula was found to be expanding at a velocity of 45 ± 10 km/sec. Three independent estimates for the radius of the nebula yielded a value of 20 pc. The age of the nebula is 1.5×10^5 yr; the kinetic energy of the envelope ejected in the outburst, 7×10^{49} ergs. The nebula is shown to be the remnant of a Type II supernova outburst, similar to IC 443 and the Cygnus Loop. (auth)

43719 SOME PROPERTIES OF THE CLASSICAL CEPHEIDS IN THE MAGELLANIC CLOUDS. Yakimova, N. N. (Astronomical

Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 1006-9(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1265-8(Nov 1971).

The relations between the brightness and color amplitudes at maximum and minimum light and at an "average" phase along curves of constant period are found to be qualitatively identical for the classical Cepheids in the Galaxy and the Magellanic Clouds, but there are significant quantitative differences, probably arising from the disparity between the chemical composition at the center and the periphery of stellar systems. Theoretical support is available for the general tendency of the amplitudes of the brightness and color variations to increase toward the low-temperature side of the instability band, an effect which is more apparent in peripheral regions. (auth)

43720 PROPER MOTIONS OF TWO OPEN STAR CLUSTERS. Koroleva, L. S. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 1018-25 (May 1972).

Translated from Astron. Zh.; 48: No. 6, 1280-8(Nov 1971).

The relative and absolute proper motions of two open clusters, NGC 6866 and 7789, were determined, using data in the author's star catalogs. Cluster members were identified from photometric and proper-motion criteria. The tangential velocities of the clusters were evaluated on the basis of published distances. (auth)

43721 SYNCHROTRON RADIATION APPLIED FOR THE ENERGY CALIBRATION OF ASTRONOMICAL EQUIPMENT. Gurzadyan, G. A.; Oganesyan, Dzh. B. (Astrophysical Observatory, Erevan). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 1026-34(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1289-1300(Nov 1971).

A special apparatus attached to a ring electron acceptor for extracting synchrotron radiation is described. The radiation is used as a short-wave and x-ray source for the energy calibration of astronomical equipment intended for operation in the space environment. A theoretical spectrum for the synchrotron radiation from this installation is derived. At wavelengths of 1500 to 4000 Å, the spectrum is practically independent of the electron energy. The energy parameters of the synchrotron beam reaching the pressure chamber are determined. The apparatus is particularly efficient when operating in the x-ray region. (auth)

43722 KINEMATICS OF FAINT M STARS NEAR THE NORTH GALACTIC POLE, AND THE MASS DENSITY IN THE SOLAR NEIGHBOURHOOD. Murray, C. A.; Sanduleak, N. (Royal Greenwich Observatory, Herstmonceux, Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 3, 273-9(1972).

Proper motions of 21 faint M stars near the north galactic pole are presented and discussed. These stars form a small sample from a large number of faint M stars found previously in a low dispersion objective prism survey. It is shown that these are probably all nearby dwarfs but that their transverse velocity dispersion is likely to be only about 10 km s^{-1}. It is suggested that these M stars belong to a numerous population, concentrated toward the galactic plane, and that they contribute significantly to the mass density in the solar neighborhood which has hitherto been unaccounted for. (auth)

43723 COLOUR-MAGNITUDE DIAGRAM OF THE GLOBULAR CLUSTER NGC 6981. Dickens, R. J. (Royal Greenwich Observatory, Herstmonceux, Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 3, 281-97(1972).

UBV photometry for stars in the globular cluster NGC 6981 = M72 is presented. The color—magnitude diagram shows a horizontal branch populated on both sides of the variable star region. The two-color $(U-B/B-V)$ diagram for field stars is used to derive a reddening of $E(B-V) = 0.07 \pm 0.01$ mag, and the two-color diagram for cluster giants used to derive an ultraviolet excess of $\delta(U-B) = 0.15 \pm 0.05$ mag at $(B-V)_0 = 1.0$. The latter value shows that the cluster is relatively metal rich, in agreement with the integrated spectral type of G3 but contrary to the Morgan II classification. A discussion of some problems associated with the interpretation of HR diagrams and other parameters of globular clusters in terms of current evolutionary theory is given. (auth)

43724 COLOUR-MAGNITUDE DIAGRAM OF THE GLOBULAR CLUSTER NGC 7099. Dickens, R. J. (Royal Greenwich Observatory, Herstmonceux, Eng.). Mon. Notic. Roy. Astron.; 157: No. 3, 299-307(1972).

UBV photometry of the globular cluster NGC 7099 is reported. The ultraviolet excess of $\delta(U-B) = 0.33$ mag shows that NGC 7099 is an extremely metal-poor cluster. The color—magnitude diagram shows a strong blue population of the horizontal branch, with very few RR Lyrae variables and stars on the red side of the instability region. The giant branch shows very little spread in color at a given magnitude. The metallicity parameter $\Delta V = 3.0$ mag is consistent with the low metal abundance. A reddening of $E(B-V) = 0.06$ mag is derived from the two-color diagram for field stars. The relative paucity of red giants in NGC 7099 probably indicates a high helium abundance. (auth)

43725 MODEL FOR TYPE I SUPERNOVAE. Hartwick, F. D. A. (Univ. of Victoria, British Columbia). Nature (London) Phys. Sci.; 237: No. 78, 137(26 Jun 1972).

It is stated that although a number of different mechanisms that could account for Type I supernovae have been suggested the problem remains open. Since these supernovae are found in elliptical galaxies, which are old stellar systems, a mechanism is required that involves stars of mass $\lesssim 1\ M_\odot$. The author suggests that hydrogen burning caused by mass transfer from a star of 0.7 to 1 $M_\odot$ to a degenerate hydrogen star of mass $\sim 0.1\ M_\odot$ may be responsible. (UK)

43726 NO EVIDENCE FOR BLACK HOLES IN ECCENTRIC BINARY SYSTEMS. Evans, W. D.; Bath, G. T. (Oxford Univ.). Nature (London) Phys. Sci.; 238: No. 79, 7-8(3 Jul 1972).

Following a suggestion by Gibbons and Hawking (Nature, 232: 465(1971)) that collapsed objects might be detected in eccentric binary systems an analysis was made of catalogued additional systems, leading to the conclusion that such objects cannot be thus detected. It was found that the anomalous eccentricity distribution of single line noneclipsing systems found by those authors also occurs in single line eclipsing systems, which are not thought to be able to contain collapsed objects. If it is assumed that eclipsing binaries cannot contain collapsed objects the data obtained indicate that the anomalous eccentricity distribution of single line binaries cannot be due to the formation of "black holes" or neutron stars. The effect of gas streams is also discussed. (UK)

43727 UNDERLUMINOSITY AND MAGNETIC FIELDS IN β LYRAE. Stothers, R. (Goddard Inst. for Space Studies, New York). Nature (London) Phys. Sci.; 238: No. 79, 5-7(3 Jul 1972).

It is stated that models proposed for the secondary component of β Lyrae involve an underluminous star embedded in a gaseous cloud, disk, or ring. An estimation is made of the underluminosity and it is shown that magnetic fields do not provide a likely explanation for this underluminosity. The minimum underluminosity of the secondary component, based on the most reliable mass ratios, appears to be 1 to 4 mag. Possibilities for explaining the underluminosity are discussed. (UK)

43728 CONCERNING THE ATMOSPHERE OF MAGNETIC NEUTRON STARS (PULSARS). Ginzburg, V. L.; Usov, V. V. (Lebedev Inst. of Physics, Moscow. Moscow Physical-Technical Inst.). JETP Lett. (USSR) (Engl. Transl.); 15: No. 5, 196-8 (5 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 5, 280-2(5 Mar 1972).

In the theory of neutron stars is the conclusion that the star should be surrounded by an extended atmosphere, in spite of the action of the force of gravity. Conditions for acquiring and maintaining this atmosphere are discussed. (W.D.M.)

43729 NUCLEAR REACTIONS IN STELLAR SURFACES AND THEIR RELATIONS WITH STELLAR EVOLUTION. Reeves, Hubert. Topics in Astrophysics and Space Physics. New York; Gordon and Breach, Science Publishers, Inc. (1971). 94p. $9.50.

Topics covered in these lecture notes include nuclear phenomena, atomic phenomena (energetics of L-element formation), stellar observations and interpretations, and theories of the origin of the light elements. (W.D.M.)

43730 IMPLICATIONS OF TACHYON-LIKE MATTER FOR SUPERDENSE STARS. Bhatia, M. S. (Bowie State Coll., Md.); Pande, L. K. Phys. Rev., D; 5: No. 12, 2936-8(15 Jun 1972).

A new equation of state of superdense matter is proposed. It is derivable by treating superdense matter as a perfect, degenerate tachyon gas. Yet the velocity of sound in the medium, β, which this equation leads to, satisfies the inequality $0 \leq \beta^2 < 1/2$. Model calculations for superdense stars based on this equation of state are presented. By appropriately choosing a certain parameter, dynamical stability can be achieved for arbitrarily large central densities. Also, a somewhat larger than usual value for the maximum mass is obtained. (auth)

43731 NONMEASURABILITY OF THE QUANTUM NUMBERS OF A BLACK HOLE. Teitelboim, Claudio (Princeton Univ., N. J.). Phys. Rev., D; 5: No. 12, 2941-54(15 Jun 1972).

Neutral-meson (scalar and vector), electromagnetic, and neutrino quantum fields interacting with classical sources on a Schwarzschild background are considered. The meson fields decouple from the source when it reaches r = 2m. This means that the coupling constant is effectively set equal to zero at the horizon. Such a phenomenon does not happen for an electromagnetic field. The sharp difference between vector mesons of any mass and photons suggests that charged black holes can exist only if the photon mass is exactly zero. Neutrinos do not decouple from the source either, but the remaining coupling is given by an unobservable phase factor. These results provide further evidence in favor of Wheeler's conjecture that the only measurable quantum numbers of a black hole are mass, charge, and angular momentum and that, consequently, the laws of conservation of baryon and lepton number are "transcended" in black-hole physics. (auth)

43732 SIMULTANEOUS PHOTOMETRY AND SPECTROSCOPY OF THE Ap STAR 108 Aqr. Megessier, C. (Observatoire, Paris); Garnier, R. Astrophys. Lett.; 11: No. 3, 113-16(Jul 1972).

Spectroscopic and photometric observations of the Ap Si 4200 star 108 Aqr show profile shapes and intensity variations of the Ti II lines which seem to be in phase with the periodic light curves. (auth)

43733 DIFFUSION AND THE ^{3}He ABUNDANCE IN 3 CEN A. Michaud, G. (Univ. of Montreal); Vauclair, S. Astrophys. Lett.; 11: No. 3, 117-18(Jul 1972).

It is shown that diffusion processes can account for the observed ^{3}He abundance in 3 Cen A and similar stars if the zone at $T >$ 100,000 K is stable, the upper zone being somehow up to at least optical depth of 0.5. (auth)

43734 SHELL STAR 88 HERCULIS: PULSATING ENVELOPE OR BINARY STAR? Harmanec, P.; Koubsky, P.; Krpata, J. (Ondrejov Observatory, Czech.). Astrophys. Lett.; 11: No. 3, 119-22(Jul 1972).

The periodic variability of the radial velocity of the shell star 88 Herculis was revealed with the semi-amplitude of about 10 km/sec. Possible consequences of this result are briefly discussed. (auth)

43735 HELIUM IN THE ORION NEBULA. Batchelor, A. S. J.; Brocklehurst, M. (University Coll., London). Astrophys. Lett.; 11: No. 3, 129-33(Jul 1972).

A variable density model of the Orion Nebula, consistent with all hydrogen recombination line and radio continuum observations which do not have high angular resolution, has been constructed by Brocklehurst and Seaton (1971, 1972). By combining this model with spatial optical observations of Peimbert and Costero (1969) the total helium abundance can be deduced. A value of $N(He)/N(H) = 0.101 \pm 0.010$ is obtained. This value is shown to be consistent with all radio recombination line observations of helium. (auth)

43736 ^{176}Lu AND S-PROCESS NUCLEOSYNTHESIS. Audouze, J.; Fowler, W. A.; Schramm, D. N. (California Inst. of Tech., Pasadena). Nature (London) Phys. Sci.; 238: No. 79, 8-11(3 Jul 1972).

The case of ^{176}Lu (half-life 2.6×10^{10} y) as a possible s-process chronometer is examined, and it is shown that s-process chronologies based on this nuclide give an important constraint on s-process nucleosynthesis in this mass region. Arguments are advanced for the s-process origin of ^{176}Lu, and application of the nucleochronologic formalism of Schramm and Wasserburg (Astrophys. J., 162: 57(1970)) to ^{176}Lu is discussed. (UK)

43737 ^{146}Sm: A CHRONOMETER FOR p-PROCESS NUCLEOSYNTHESIS. Audouze, J.; Schramm, D. N. (California Inst. of Tech., Pasadena). Nature (London); 237: No. 5356, 447-9(23 Jun 1972).

It is stated that hitherto nucleosynthetic chronologies have been proposed only for r-process nuclei; nucleosynthesis of the rare proton-rich isotopes is generally attributed to an as-yet poorly understood p-process. The use of the p-process radioisotope ^{146}Sm (half-life 7×10^7 y) is proposed as a possible nucleochronometer. The development of a p-process chronology would provide information concerning when the p-process occurred and might provide a clue regarding the astrophysical site of the p-process. The half-life of ^{146}Sm allows its use for the determination of the time between the end of p-process nucleosynthesis and the formation of solid bodies in the solar system. The relative p-process production of ^{146}Sm is estimated and a measurement proposed that would enable it to be used as a nucleochronometer. A discussion is included on the p-process itself. With an approximate 10^8 y lifetime, the ^{146}Sm present at the time of solidification is not available for observation at the present time, 4.6×10^9 y later, but ^{146}Sm undergoes α-decay to ^{142}Nd; hence, the isotopic composition of Nd should vary with the amount of Sm with which it was in contact at solidification. The amount of cosmogenic ^{142}Nd is proportional to the Sm/Nd elemental ratio in a sample, and a way to determine the parameters of the p-process nucleochronology is to look for ^{142}Nd anomalies in meteorites, using mass spectrometry. The possibility also arises that the hypothesis in which the time of the p-process is correlated with that of the r-process could be critically examined. (UK)

43738 HADRONIC EQUILIBRIUM-CONFIGURATIONS. Moellenhoff, C. (Univ., Goettingen, Ger.). Astron. Astrophys.; 19: No. 3, 326-36(Jul 1972).

Hagedorn's hadronic equation of state is used to construct relativistic spheres consisting of a pure hadron-gas with zero total baryon number. Their equilibrium configurations are uniquely determined by their central densities. Mass and radius vary only slightly when the central density changes. Only the configurations with the (for hadronic matter) low central density of $\rho_c < 3.8 \times 10^{14}$ g cm^{-3} are dynamically stable. There exists an upper limiting mass for stable hadron spheres ($M_{cr} = 1.04 \times 10^{34}$ g, $R_{cr} = 2.44 \times 10^6$ cm) which is reached at the central density $\rho_c = 3.8 \times 10^{14}$. The configurations made from a pure hadron gas are good approximations for the core of an extremely hot star in which the core structure is determined by hadrons, muons, photons, electrons, and neutrinos. (auth)

43739 MASS FLOW AND PERIOD CHANGES OF CONTACT BINARIES. Van't Veer, F. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 19: No. 3, 337-42(Jul 1972).

Period changes of eclipsing contact binaries are interpreted as the consequence of mass flows from the first and second lagrangian points L_1 and L_2. The measured values of the rate of period change dP/dt are related to the rate of mass outflow dm/dt. A distinction is made between binaries with a well-developed common envelope and binaries for which such an envelope is supposed to be absent or is at least still capable of absorbing large quantities of stellar matter. The following possibilities of material flow are studied separately: (1) From L_1 to the envelope, (2) from L_1 or L_2 to outer space, (3) from one component to the other. Formulae are given for the rate of increase or decrease of the orbital radius and the period as a function of the rate of mass transport and the mass ratio of the components in a certain number of idealized cases. The stellar orbits are supposed to be circular and the angular momentum due to the (synchronized) stellar rotation is taken into account. A short discussion of some evolutionary aspects is also given. (auth)

43740 ATMOSPHERES OF A-TYPE SUPERGIANTS. Aydin, Cemal (Ankara Univ. Astronomical Observatory, Trieste, Italy). Astron. Astrophys.; 19: No. 3, 369-80(Jul 1972).

Five A-type supergiant stars were studied and compared with α Cygni. Microturbulence and radial velocity and their dependence upon EP and time were studied. All the objects presented a Balmer line radial velocity progression; for four of them this progression indicated an expansion of the higher atmospheric layers and for one (HD 21389) a contraction. The progression was variable with time. All the stars presented radial velocity of the metallic lines variable with time. In all cases the microturbulence was different from one element to another, and always $v(Fe\ II) > v(Ti\ II) > v(Fe\ I)$. A correlation between radial velocity and microturbulence variations was found in one case: the A2 Ib star HD 39866. (auth)

43741 TWO NEW He I LINES IN THE SPECTRA OF B-TYPE SUPERGIANTS. Van Helden, R. (Astronomical Inst., Utrecht). Astron. Astrophys.; 19: No. 3, 388-92(Jul 1972).

In the spectra of supergiants of spectral type B5 Ia to B0 Ia the transitions 3p $^3P^0$–9d ^3D and 3p $^3P^0$–10d ^3D in atomic helium provide absorption lines at 8776.74 Å and at 8582.65 Å, respectively. Seven supergiants are found with He I 8582.65 in their spectra. The line is luminosity sensitive, it is not encountered in lower luminosity B-type stars. It is argued that the 3 $^3P^0$ state of atomic helium is overpopulated by a selective mechanism. (auth)

43742 CHROMOSPHERIC HEATING OF VERY HOT STARS BY RADIATION DRIVEN SOUND WAVES. Hearn, A. G. (Univ. of Queensland, Brisbane, Australia). Astron. Astrophys.; 19: No. 3, 417-26(Jul 1972).

A mechanism for the chromospheric heating of very hot stars is suggested. A linearized theory shows that sound waves will be amplified by an interaction of the perturbations of the absorption coefficient caused by the sound wave with the radiative forces, that is the gradient of the radiation pressure. An e-folding length for the amplification of the sound waves is calculated, which corresponds to an optical depth of less than unity in the outer layers of a star of effective temperature of 63,000°K and surface gravity 10^4 cm s^{-2}. It is suggested that this mechanism could explain some of the observed properties of Wolf–Rayet stars and possibly contributes to the formation of planetary nebulae and the ejection of matter from novae. (auth)

43743 RADIAL VELOCITIES MEASUREMENT WITH THE COUDE SPECTROGRAPH OF THE 152 cm TELESCOPE. Fehrenbach, Ch. (Observatoire, Haute Provence, France). Astron. Astrophys.; 19: No. 3, 429-33(Jul 1972). (In French).

The method of analysis used at the Haute Provence Observatory for plates taken with the coudé spectrograph of the 152-cm telescope (dispersion 20 Å mm^{-1}) is described. Wavelength tables for F5 to M (III to V), FIa to GIa stars, and a special table for A8 to F5 stars are given. Radial velocities measures for 25 IAU Standard stars are compared. These tables were used for RV determination of 13 Large Magellanic Cloud supergiants observed at the European Observatory in Chile (ESO) (8 stars of Classes B9 to A8–5 stars F to G). (auth)

43744 ABUNDANCES IN LATE-TYPE GIANTS. Gottlieb, D. M.; Bell, R. A. (Univ. of Maryland, College Park). Astron. Astrophys.; 19: No. 3, 434-52(Jul 1972).

The narrow-band photometry of Spinrad and Taylor (1969) was analyzed by the synthetic spectra technique. Surface gravities, Doppler broadening velocities, effective temperatures, and metal abundances were determined for 131 K giants. Evolutionary tracks and gravities determined from the photometry were used to give space positions, space velocities, and absolute magnitudes of the 131 stars. It was concluded that a class of stars exists with metals and/or nitrogen significantly enhanced with respect to the Sun; further that these stars have average space motions similar to those of moderately old Population I stars. The Doppler broadening velocity was found to be a strong function of temperature for K giants, and in some cases, possibly a function of surface gravity. Three clusters—the Hyades, NGC 188, and M67—were found to have metal abundances greater than the Sun's. (auth)

43745 BLANKETED MODEL ATMOSPHERES FOR COOL HYDROGEN-RICH WHITE DWARFS. Wehrse, R. (Univ., Kiel). Astron. Astrophys.; 19: No. 3, 453-72(Jul 1972).

Model atmospheres for cool hydrogen-rich white dwarfs were constructed under the assumption of $T_{eff} = 5700°K$ and $T_{eff} = 5100°K$, log g = 8, and solar composition. The blanketing effect of more than 23,800 atomic and molecular lines was taken into account in a statistical approach. Transition probabilities for all lines were derived from the Rowland Tables (Moore et al., 1966) by means of Holweger's empirical solar model (1967). Line absorption from molecular and atomic lines is strongly increased by high pressure and causes large blanketing vectors in the two-color diagram: In the case of $T_{eff} = 5700°K$ $\Delta(U-B) = -1.08$ and $\Delta(B-V) = -0.19$ mag compared to line-free models. The temperature gradient is steepened in such a way that convection sets in at $\bar{\tau} \approx 0.1$, which appreciably changes the energy distribution as compared to a radiative model. The colors of the models agreed fairly well with observed positions of cool white dwarfs of type DK in the UBV (R–I, B–V), and (M_v, U–V) diagrams, which supports the hypothesis by Weidemann (1966) that these stars might be cooled-down DA objects, but yet no definite conclusion on the abundances of DK stars could be drawn. Deviations from solar metal abundances were indicated by the prediction of a strong Ca I 4227 Å line and CH G band in the models, which were not visible in DK spectra. (auth)

43746 MULTIPLE SOLUTIONS OF THE EQUATION OF STELLAR STRUCTURE. Lauterborn, D. (Univ. of Colorado, Boulder). Astron. Astrophys.; 19: No. 3, 473-81(Jul 1972).

Three solutions are shown to exist, in a certain range of parameters, for a giant envelope for which four boundary conditions (two atmospheric boundary conditions, and radius and luminosity at the bottom of the envelope) are specified. Such triple solutions occur independent of whether or not the hydrogen burning region is included in the envelope. In the H–R diagram, two of the solutions are close to each other and to the Hayashi line, while the third solution is completely radiative and at some distance from the Hayashi line. (auth)

43747 SEARCH FOR He-WEAK STARS IN VERY YOUNG CLUSTERS. Bernacca, P. L. (Goddard Space Flight Center, Greenbelt, Md.); Ciatti, F. Astron. Astrophys.; 19: No. 3, 482-8(Jul 1972).

Spectral classification was carried out for B-type stars in Ori O Bl Ib, NGC 2362, IC 5146, and NGC 2264. Six stars with weak helium lines for their UBV colors were found in Ori OBl Ib, one in NGC 2362 which might be helium-variable, none in IC 5146. The star Walker No. 109 (B6V) in NGC 2264 is a helium variable which has developed an outstanding absorption feature between 4144 Å and 4156 Å. (auth)

43748 SIMULATION OF FIELD STARS IN NUMERICAL EXPERIMENTS. Henon, M. (Observatoire, Nice). Astron. Astrophys.; 19: No. 3, 489-91(Jul 1972).

In some recent numerical experiments, field stars were simulated inside a sphere as follows: first an initial position was selected on the surface of the sphere, and then the direction of the velocity was chosen randomly, with an isotropic probability distribution. It is shown that this method is incorrect and produces systematic errors in the results. (auth)

43749 LIMB DARKENING PROBLEM IN ECLIPSING BINARIES. Grygar, J. (Astronomical Inst., Ondrejov, Czech.); Cooper, M. L.; Jurkevich, I. Bull. Astron. Inst. Czech.; 23: No. 3, 147-74(1972).

During the past sixty years increasing attention has been given to the problem of limb darkening in eclipsing binaries. With the exception of the Sun, eclipsing binaries are the only stars for which an empirical determination of limb darkening is possible. Reliable estimates of limb darkening values are of importance not only in the solution for elements of eclipsing binaries, but are also required for measurements of stellar diameters, calculation of rotationally broadened line profiles, and for interpretation of lunar occultations of stars. Recent developments bearing on precise determinations of limb darkening as well as pertinent results are reviewed in the present survey. (auth)

43750 LIMB DARKENING FOR B-TYPE MAIN SEQUENCE STARS IN THE INFRARED. Grygar, J. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 23: No. 3, 175-7(1972).

Limb darkening laws and the respective linear coefficients u′ are tabulated for seven model stellar atmospheres and four wavelengths in the infrared region (14,588 to 58,353 A). The models, constructed by Underhill, were identified with main-sequence stars of spectral types B 3 to B9. A survey of available infrared limb darkening calculations is also given. (auth)

43751 DETERMINATION OF THE ELEMENTS OF SYNTHETIC CLOSE BINARIES. Horak, T. B. (Univ. of South Florida, Tampa). Bull. Astron. Inst. Czech.; 23: No. 3, 178-80(1972).

Wilson's and Devinney's synthetic light curves of close binaries were used to determine the elements by means of the automatic iterative minimization method. An approximate rectification formula was used. The results are satisfactory if the eclipses are complete. An attempt to improve the solution using the ellipsoid–ellipsoid model failed. (auth)

43752 PHOTOELECTRIC UBV PHOTOMETRY IN CYGNUS AND CASSIOPEIA. Bern, K.; Virdefors, B. (Univ. of Lund, Sweden). Astron. Astrophys., Suppl. Ser.; 6: No. 2, 117-30 (Jun 1972).

Photoelectric measurements in the standard UBV-system are presented for 39 stars in Cygnus and 74 stars in Cassiopeia. (auth)

43753 PHOTOELECTRIC OBSERVATIONS OF SIX ECLIPSING BINARIES. van der Wal, P. B.; Nagel, C.; Voordes, H. R.; de Boer, K. S. (Sterrenkundig Laboratorium Kapteyn, Groningen, Netherlands). Astron. Astrophys., Suppl. Ser.; 6: No. 2, 131-45(Jun 1972).

Observations are reported of the eclipsing binaries: QS Aql, EG Cep, FZ Del, AK Her, LS Her, and EW Lyr. The suspected eclipsing binary AT Her was also measured and found to be of constant brightness. A special way of reduction for slowly varying extinction is explained. As a part of the reduction it appears that the V magnitude of the UBV standard star BD + 3° 4065 has increased by 0.18 magnitudes. (auth)

43754 COMPUTER CALCULATION OF THE PRELIMINARY ELEMENTS OF ECLIPSING BINARIES. Minti, Hari (Astronomical Observatory, Bucharest). Stud. Cercet. Astron.; 17: No. 1, 45-52(1972).

An algorithm used for the determination of the preliminary elements of the eclipsing binaries is described on the basis of the χ method of Russell and Merrill (1952). The rectified χ is calculated at the beginning of the suggested method, taking into account all normal points within the respective eclipse. The characteristic functions of the eclipse α and χ are calculated on the computer using the polynomial approximation functions for $^{10}\alpha^{oc}$ and $^{10}\alpha^{tr}$ suggested by Fliegel and Wilson (1968) and $^{10}\alpha^{ann}$ suggested by the author (1970). The method is applied to the rectified light curve of the eclipsing binary AB Andromedae available from a recent paper of the author (1971) concerning this system. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 43042, 43043, and 43709.

43755 (N-72-17849) MIT OSO-7 X-RAY EXPERIMENT: A FIVE-COLOR SURVEY OF THE POSITIONS AND TIME VARIATIONS OF COSMIC X-RAY SOURCES. Final Report, December

1967–November 1971. Taylor, Richard S.; Clark, George W. (Massachusetts Inst. of Tech., Cambridge. Center for Space Research). Nov 1971. Contract NAS5-11082. 239p. (NASA-CR-122338). NTIS.

The all-sky, x-ray measurements are made in five broad energy bands from 0.5 to 60 keV with x-ray collimators of one- and three-degree FWHM response. Working with the onboard star sensor, source locations may be determined to a precision of ±0.1°. The experiment is located in wheel compartment number three of the spacecraft. A time division logic system divides each wheel rotation into 256 data bins in each of which x-ray counts are accumulated over a 190-second interval. Measurement chain circuits include provision for both geometric and risetime anti-coincidence. A detailed description of the instrument is included as is pertinent operating information. (auth) (STAR)

43756 OPTICAL IDENTIFICATION OF RADIO-SOURCES SELECTED FROM THE B2 CATALOGUE. Grueff, G. (California Inst. of Tech., Pasadena); Vigotti, M. Astron. Astrophys., Suppl. Ser.; 6: No. 1, 1-83(May 1972).

Two samples of radio sources, statistically complete to 0.25 and 0.90 flux units at 408 MHz in restricted areas, were selected from the B2 Survey to attempt their optical identification on the Palomer Sky Survey. More accurate declinations were measured for all the 466 radio sources, using the interferometer of the Owens Valley Radio Observatory. The accuracy of the final radio-positions was of the order of 6 to 12 arc sec in R. A., and 2.5 to 20 arc sec in dec. These positions were located on the Palomar Sky Survey plates with an accuracy of 2 arc sec. Identification is suggested for a total of 104 radio galaxies and 73 quasi-stellar objects. Finding charts and reference star positions are provided for all the fields investigated. (auth)

43757 OBSERVATIONS AT 2700 MHz OF SELECTED PLANETARY NEBULAE. Aller, L. H.; Milne, D. K. (CSIRO, Epping, Australia). Aust. J. Phys.; 25: No. 1, 91-6(Feb 1972).

Observations at 2700 MHz of 74 planetary nebulae were obtained with the Parkes 64 m radio telescope. Comparison is made with the optically determined Hβ intensity to obtain extinction coefficients in these directions. (auth)

43758 CALIBRATION OF THE FLUX DENSITY OF CASSIOPEIA A AND CYGNUS A IN THE RANGE 300 TO 9375 MHz. Troitskii, V. S.; Stankevich, K. S.; Tseitlin, N. M.; (and others) (Gorky State Univ., USSR). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 915-17(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1150-3(Nov 1971).

A continuation of the program for absolute precision measurements of the radio flux densities of discrete sources by the "artificial moon" method is reported. The purpose of the program is to obtain detailed radio spectra of the strongest discrete sources and to record possible spectrum variations. (auth)

43759 RADIO MAP OF THE CRAB NEBULA AT 3.5 mm. Matveenko, L. I. (Inst. for Space Research, Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 918-22(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1154-9(Nov 1971).

The Crab Nebula has been observed at 3.5-mm wavelength with the 36-ft radio telescope of the National Radio Astronomy Observatory at Kitt Peak. A radio map of the nebula is derived. The isophote at the 3-dB level is elliptical, with its major axis measuring 3.92′ ± 0.20′ and its minor axis 2.41′ ± 0.20′. In the α direction the brightness distribution is symmetrical and has sharp edges; in the δ direction the southern boundary is sharp but a gradual falloff is observed toward the north. The coordinates of the nebula relative to the pulsar are $\Delta\alpha = -48'' \pm 8''$, $\Delta\delta = -5'' \pm 8''$. The flux density at 3.5 mm is 200 ± 15 flux units. The percentage polarization $P = (9 \pm 8)\%$. (auth)

43760 OBSERVATIONS OF THE HIGH-ENERGY GAMMA-RAY FLUX FROM THE EXTRAGALACTIC SOURCE 3C 120. Volobuev, S. A.; Gal'per, A. M.; Kirillov-Ugryumov, V. G.; Luchkov, B. I.; Ozerov, Yu. V. (Moscow Engineering Physics Inst.). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 879-85 (May 1972).

Translated from Astron. Zh.; 48: No. 6, 1105-13(Nov 1971).

The γ-ray detectors on the Cosmos 251 and 264 satellites recorded an excess flux of γ rays of energy $E_\gamma \geq 100$ MeV with an intensity $\approx 5 \times 10^{-4}$ $(\mathrm{cm}^2 \cdot \mathrm{sec})^{-1}$, arriving from a region of space bounded by $\alpha = 3.6$ to 5.0^h, $\delta = 4-9°$. The most probable source of this flux is the N galaxy 3C 120, a strong source of infrared and irregularly variable short-wave radio emission. One of its radio bursts agrees in time with the excess γ ray flux, which was observed for $\approx 5 \times 10^5$ sec and implies a power of $\approx 2 \times 10^{47}$ ergs/sec for the flare. (auth)

43761 NATURE OF X-RAY SOURCES OF THE SCORPIUS X-1 TYPE. Shklovskii, I. S. (Inst. for Space Research, Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 886-91(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1114-21(Nov 1971).

An analysis of the soft x-ray absorption at $h\nu < 0.5$ keV in the spectrum of Sco X-1 suggests that the source is surrounded by a relatively cool plasma envelope with $T_e = 135{,}000$°K, $N_e = 2 \times 10^{16}$ cm^{-3}, and a radius $R_2 = 2 \times 10^9$ cm. The surface of this outer envelope would be responsible for the optical emission of Sco X-1. The inner zone of the source, responsible for its x rays, would have a size $3 \cdot 10^7 < R_1 < 10^9$ cm and 5×10^{18} cm$^{-3} > N_e > 3 \times 10^{16}$ cm^{-3}, with $T = (0.3 - 1.0) \times 10^8$°K. If the mass of the Sco X-1 nucleus exceeds 10^{-3} $M_\odot$, the hot plasma in its envelopes could not be in hydrostatic equilibrium. Individual plasma clouds should move in the vicinity of the nucleus considerably faster than the thermal velocity. Accretion cannot explain the motion of the clouds or the observed energy release. Several arguments are given against the "close binary system" interpretation of the Sco X-1 phenomenon. A new explanation is suggested for the "mirror image" radial-velocity variations of the He II and H I lines in the spectra of Sco X-1 and Cyg X-2. The hypothesis is offered and supported that objects of the Sco X-1 type are x-ray "novae." The motion of plasma around the nucleus of such a source should be controlled by a regular magnetic field. The problem of the radiant-energy sources in objects of the Sco X-1 type is discussed briefly. (auth)

43762 DETERMINATION OF THE PROPERTIES OF A SYNCHROTRON-RADIATION SOURCE FROM ITS SPECTRUM. Sazonov, V. N. (Lebedev Inst. of Physics, Moscow. Physical-Technical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 946-9(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1190-4(Nov 1971).

The spectral index α for the synchrotron radiation from a transparent (nonabsorbing) source can vary with ν only within the range $-[(\alpha_{\max} + 1/3)^2/2] \leq \nu(d\alpha/d\nu) \leq \alpha + \alpha^2 + 0.40$, whatever the energy distribution of the radiating electrons or the strength and directional distribution of the magnetic field over the source. If either of the inequalities for $\nu \times d\alpha/d\nu$ is violated (as probably occurs at the "step" in the spectrum of Cyg A), the deviation of the source spectrum from a power-law dependence of α on ν cannot be explained by assuming a nonpower distribution of electrons in a transparent source. One possible interpretation would be to postulate that the source contains compact objects wherein radiation is absorbed, perhaps by self-absorption. (auth)

43763 MEAN MAGNETIC FIELD IN THE DIRECTION OF THE PULSAR AP 1237 + 25, AND ITS LINEAR POLARIZATION. Vitkevich, V. V.; Malofeev, V. M.; Shitov, Yu. P. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 1059-60(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1333-5(Nov 1971).

Observations carried out at Arecibo and Pushchino at 111.5 and 85.5 MHz indicated that the radio emission of the pulsar AP 1237 + 25 has an average linear polarization of 45%. The rotation measure was found to be 16 ± 4 rad/m^2, corresponding to a mean longitudinal component for the interstellar magnetic field in the direction toward the pulsar of $2.1 \pm 0.5 \cdot 10^{-6}$ G. (auth)

43764 EXTRAGALACTIC X-RAY SOURCES. Brecher, K.; Burbidge, G. R. (Univ. of California, San Diego, La Jolla). Nature (London); 237: No. 5356, 440-3(23 Jun 1972).

It is stated that the extended x-ray sources associated with the Virgo, Perseus, and Coma clusters of galaxies can best be explained as a result of the Compton scattering of relativistic electrons (generated in the radio sources which are present in each of these clusters) on the microwave background radiation. The same physical process involving microwave infrared or optical photons generated in the nuclei of active galaxies may account for the more compact x-ray sources. Thermal bremsstrahlung of hot gas in clusters of galaxies is a less likely source of x-rays. (auth)

43765 PULSATING X-RAY SOURCES. Chanmugan, G. (Louisiana State Univ., Baton Rouge). Nature (London); 237: No. 5356, 449-50(23 Jun 1972).

It has been suggested that pulsating x-ray sources, with periods ~1 sec., are associated with matter at high densities and in particular with white dwarfs, neutron stars, or black holes. The timing of the x-ray pulses does not appear to have the essential constancy of that of pulsars, suggesting that rotation is not the most likely explanation of the pulsations. Neutron stars have oscillation periods that are too short to fit the case, and it is difficult to explain the short-period x-ray sources in terms of oscillating white dwarfs. The author suggests that these x-ray sources are vibrating stars with central densities intermediate between those of neutron stars and white dwarfs, and are probably undergoing slow collapse eventually to become neutron stars or black holes. (UK)

43766 LR CEN IS NOT CEN X-3. Peterson, B. A. (Australian National Univ., Canberra). Nature (London); 237: No. 5357, 508(30 Jun 1972).

It has been suggested that the eclipsing variable LR Cen is a candidate for the optical counterpart of Cen X-3, on the basis of near coincidence of position and period. It is considered, however, that the difference in periods, although small, is significant. A redetermination of the period of LR Cen was made, showing that it is significantly different from that of Cen X-3, and it is concluded that LR Cen is not the optical counterpart of Cen X-3. (UK)

43767 RADIO OBSERVATIONS OF CYGNUS X-3. Hjillming, R. M.; Hermann, M.; Webster, E. (National Radio Astronomy Observatory, Green Bank, W. Va.). Nature (London): 237: No. 5357, 507-8(30 Jun 1972).

Observations of the radio counterpart of Cyg X-3 at 2,695 and 8,085 MHz with NRAO interferometer of spacings of 2,400, 1,900, and 500m are reported. Data taken from April 29, to May 3, 1972 confirmed the presence of a very variable radio source at a position 2.1 arc min. from the position of Cyg X-3 as recently determined from satellite data. The radio source was an unresolved point source and an upper limit of 0.5 arc sec. could be placed on its angular diameter. It was found that Cyg X-3 is the strongest of present-known x-ray stars at these radio frequencies and, unlike Sco X-1, the source is strongest at high frequencies. The Cyg X-3 radio counterpart behaved as expected for a variable thermal radio source, and there was strong similarity between the radio data of Cyg X-3 and β Persei. The empirical similarity in time scale, spectral index variation and so on, suggests that the physical mechanisms responsible for the radio emission in these two stars are the same; it has been suggested that the β Persei radio source is primarily a hot thermal bremsstrahlung source that should be a transient x-ray source. Cyg X-3 may contain both thermal and nonthermal components, with nonthermal behavior rare. (UK)

43768 RADIO DETECTION OF CYGNUS X-3. Braes, L. L. E.; Miley, G. K. (Leiden Observatory, Netherlands). Nature (London): 237: No. 5357, 506(30 Jun 1972).

It is stated that during a continuing search for radio emission from x-ray sources, using the Westerbork synthesis telescope, a highly variable radio source was detected near the x-ray location of Cyg X-3 (2 ASE 2030 + 40). Dates and mean flux densities for the observations are shown tabulated. It appears that over a period of a few months the source varied by an order of magnitude, and the extreme variability and near positional coincidence give confidence that it is the radio counterpart of Cyg X-3. It also appears that the 1415-MHz flux density varied appreciably on a time scale of hours, in contrast with Cyg X-1 which does not show such rapid variations. Stringent upper limits were also set to the mean linear and circular polarization for the times when the Cyg X-3 source was strongest. With a peak flux density of 230×10^{-29} W m^{-2} Hz^{-1} Cyg X-3 is so far the brightest galactic x-ray object at 1415 MHz. The ratio of its radio to x-ray luminosity is about 50 times greater than for Cyg X-1 and exceeds that for Sco X-1 by more than two orders of magnitude, and this, together with the unique character of its x-ray spectrum, suggests a completely different type of object. (UK)

43769 STRUCTURE OF THE CRAB NEBULA AT 2.7 AND 5 GHz. I. THE OBSERVATIONS. Wilson, Andrew S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.: 157: No. 3, 229-53(1972).

Maps of the brightness and polarization distributions over the Crab Nebula were made with the Cambridge One-Mile telescope at 2.7 and 5 GHz, the resolution being $6'' \times 16''$ arc at the latter frequency. The main features of these maps are described. The main results are (i) the basic similarity of the radio nebula to that of the optical continuum although the radio size is large, (ii) the absence of any significant variation of spectral index over the source between 0.4 and 5 GHz, (iii) the presence of radio features associated with the bright optical filaments emitting line radiation, (iv) complex structure in the distribution of linear polarization, and (v) a general depolarization with increasing wavelength, but stronger depolarization by the bright filaments. The differences between the planes of polarization at 5 and 1.4 GHz are fairly constant over the source, but those between optical frequencies and 5 GHz show a large scatter. The radio polarization, unlike that at optical wavelengths, shows no relation to the optical bays. (auth)

43770 PULSES OF GRAVITATIONAL RADIATION OF A PARTICLE FALLING RADIALLY INTO A SCHWARZSCHILD BLACK HOLE. Davis, Marc; Ruffini, Remo; Tiomno, Jayme (Princeton Univ., N. J.). Phys. Rev., D; 5: No. 12, 2932-5(15 Jun 1972).

Using the Regge–Wheeler–Zerilli formalism of fully relativistic linear perturbations in the Schwarzschild metric, the radiation of a particle of mass m falling into a Schwarzschild black hole of mass $M \gg m$ is analyzed. The detailed shape of the energy pulse and of the tide-producing components of the Reimann tensor at large distances from the source are given, as well as the angular distribution of the radiation. Finally, analysis of the energy going down the hole indicates the existence of a divergence; implications of this divergence as a testing ground of the approximation used are examined. (auth)

43771 ANOMALOUS MOTION OF RADIATING PARTICLES IN STRONG FIELDS. Jaffe, Jack (Goddard Space Flight Center, New York). Phys. Rev., D; 5: No. 12, 2909-11(15 Jun 1972).

The anomalous motion of radiatively damped particles in a uniform magnetic field is analyzed. A particularly simple method of solution is presented, and some possible astrophysical consequences of the motion are briefly discussed. (auth)

43772 PULSATION MECHANISM OF STELLAR X-RAY SOURCES. Hayakawa, Satio (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1452-3(Apr 1972).

Several authors have recently reported that x rays are emitted as pulse trains of varying periods for cosmic x-ray sources Sco X-1 and Cyg X-1. The drift of the period has also been found, in particular by Oda et al. (to be published). In this note it is pointed out that the phenomenon can be explained by extending the acoustic vibration model proposed by Feldman et al. (Nature, 226: 432 (1970). (L.M.T.)

43773 QUASI-STELLAR OBJECTS. Aizu, Ko (Rikkyo Univ., Tokyo); Tabara, Hiroto; Taketani, Mituo. Progr. Theor. Phys. (Kyoto), Suppl.; No. 49, 228-47(1971).

The theory of QSOs is reviewed. According to this theory a QSO is an active stage in the evolution of a galaxy, where successive explosions occur in condensations in the nucleus during $\sim 10^4$y. The condensation is a system of gas and stars with mass $\sim 10^5 M_{\odot}$. Luminosity functions at three different epochs are determined and using these luminosity functions the lifetime of the active stage of a QSO—QSO(Q) stage—as $\sim 10^4$y is estimated. It is shown that observational results at high frequencies (≥ 3 GHz) of very small radio structures ($\leq 10^{-3}{''}$), the radio spectrum and its time variations can be consistently explained by synchrotron radio emission from a single expanding plasma cloud produced by an explosion in a condensation. This cloud contains relativistic electrons and magnetic field and is optically thick for radio waves in the initial stage of expansion. Energy supply from the condensation to the cloud continues for 10 ~ 30 y. These explosions occur every 30 ~ 70 y. Observational results at low frequencies (0.3 ~ 3 GHz) of radio structures ($\sim 10^{-2}{''}$) and spectral shapes can be explained as the superposition of radio emission from a large number of expanding clouds. Evolution of a composite sources is discussed on the luminosity versus the volume emissivity diagram. (auth)

43774 PHYSICAL PROCESSES INVOLVED IN THE DUST SURROUNDING STARS. GRAIN MASS AND PROTON ACCRETION. Pecker, J. C. (Centre National de la Recherche Scientifique, Paris). Compt. Rend., Ser. B; 274: No. 16, 1001-6(17 Apr 1972). (In French).

The effect of proton–grain collisions on the grain size in H II regions was studied. It is shown that the direction of the evolution of a grain (building up or destruction) depends on the unknown value of the adhesion probability xi. The kinetics of the evolution depends essentially on the grain charge; this leads to the conclusion that in H II regions, positively charged grains are predominant. It seems that grains cannot be generated inside H II regions; their presence inside such regions indicates their existence prior to the formation of the region. (France)

43775 INJECTION OF RELATIVISTIC PARTICLES INTO A PULSAR WAVE ZONE BY A NEAR-ZONE STELLAR WIND. Henriksen, R. N.; Rayburn, D. R. (Queen's Univ., Kingston, Ont.). Astrophys. Lett.; 11: No. 3, 107-12(Jul 1972).

It is shown that a relativistic stellar-breeze solution gives a precise description of "magnetic sling" acceleration of the kind first suggested in the Gold pulsar model. Relativistic particles are produced by corotation at the Dicke–Alfvén point (near the light radius) in a low particle-flux limit, and are subsequently injected into the wave zone. The ratio precursor pulse of the Crab pulsar NP 0531 is tentatively identified with the radiation produced by the corotating charged particles. Combined with the other directly observed properties the theory allows one to estimate typical values of the proper mass flux, total energy flux, magnetic moment, moment of inertia, and proper mass density in the corotating region as: $\sim 10^{14.3}$ gm sec^{-1}, $\sim 10^{38.2}$ erg sec^{-1}, $\sim 10^{23.3}$ Gauss cm^2 sr^{-1}, $\sim 10^{44.5}$ gm cm^2 and $10^{-12.8}$ gm cm^{-3}, respectively. The corresponding Lorentz factor of the particles is typically $10^{2.5}$. (auth)

43776 OPTICAL DEPTHS OF NEUTRAL HYDROGEN CLOUDS DETERMINED BY POLARIZATION TECHNIQUES. Gardner, F.

F.; Whiteoak, J. B. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Lett.; 11: No. 3, 123-8(Jul 1972).

Observations were made of the hydrogen-line-absorption of the linearly polarized continuum of five radio sources. With the polarization method it was possible to determine at each position the optical depth and the "expected emission profile," provided that the direction of polarization and the opacity did not both vary across the beam. The results at eleven positions across Centaurus A yielded optical depths varying from 0.27 to 0.11, with lower values over the polarized NE component of the central double continuum source. (auth)

43777 EXTRAGALACTIC RADIO SOURCES AND ANGULAR RESOLUTION AT 25 x 10^{-6} ARC SEC. Lovelace, R. V. E. (National Astronomy and Ionosphere Center, Arecibo, Puerto Rico. Cornell Univ., Ithaca, N. Y.); Backer, D. C. Astrophys. Lett.; 11: No. 3, 135-8(Jul 1972).

Detection or limits on weak intensity variations of extragalactic radio sources with time scale of about an hour at frequencies 2 to 20 GHz due to interstellar scintillations could provide information on very small-angle structure, $\lesssim 25 \times 10^{-6}$ arc sec. Over this frequency range the incoherent synchrotron theory of the emission of radio sources suggests minimum sizes in the range (60 to 600) $\times$ 10^{-6} arc sec and, because of the inverse Compton effect, brightness temperatures $\lesssim 10^{12}$ K. Smaller angular structure could exist with higher brightness temperatures, however, if coherent radiation processes are involved. The highest brightness temperatures which can be measured from the Earth by interferometry are $\lesssim 10^{12}$ K. Much higher brightness temperatures would be implied however by the occurrence of interstellar scintillations. (auth)

43778 STRUCTURE OF THE RADIO SOURCES PKS 0118 + 03, PKS 2053-20, AND PKS 2057-17. Hazard, C. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Astrophys. Lett.; 11: No. 3, 139-46(Jul 1972).

The detailed structure of three radio sources derived from occultation observations is described. Two of the sources, PKS 0118 + 03 and 2053 − 20, are basically double while PKS 2057 − 17 is possibly double. PKS 2053 − 20 and 2057 − 17 are identified with elliptical galaxies, and PKS 0118 + 03 is identified with a QSO. In all three cases, however, the radio components appear to be several seconds of arc in extent. (auth)

43779 SEARCH FOR RAPIDLY VARYING RADIO SOURCES. Harvey, G. A.; Andrew, B. H.; Macleod, J. M.; Medd, W. J. (National Research Council, Ottawa). Astrophys. Lett.; 11: No. 3, 147-9(Jul 1972).

An attempt to find new, rapidly-varying radio sources was made during the period October−November 1971. Nineteen sources were studied, but no new rapid variables were discovered. (auth)

43780 FINE STRUCTURE OF 3C 225. Kapahi, V. K.; Joshi, M. N.; Krishna, Gopal (Tata Inst. of Fundamental Research, Bombay). Astrophys. Lett.; 11: No. 3, 155-8(Jul 1972).

The radio positions and structures of components of the extragalactic radio source 3C 225 were derived with a resolution better than 1 arc sec from a lunar occultation observed with the Ooty radio telescope at 326.5 MHz. The two known components of 3C 225, separated by about 6.25 arc min, were further resolved into simple close-doubles with compact subcomponents. The suggested optical identification for one of the two components and the relative orientation of the close doubles support the hypothesis that the two widely separated components are physically unrelated. (auth)

43781 4830 MHz OBSERVATIONS OF THE FORMALDEHYDE MOLECULE IN THE DIRECTION OF DISCRETE RADIO SOURCES. Wilson, T. L. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 19: No. 3, 354-68(Jul 1972).

Observations were made of the formaldehyde (H_2CO) molecule against the peaks of 74 continuum sources using the NRAO 140-foot radio telescope. Sixty-three of the sources were selected from the H 109α line survey of Reifenstein et al. (1970). The angular resolution of the telescope was 6.5 arc minutes, and the frequency resolution for nearly all the measurements was 1.7 km/s. The results of the survey were used to assist in resolving the twofold kinematic distance ambiguity for many of the H II regions observed. Four of the H II regions observed showed large deviations from circular motion, indicating some caution should be exercised in regard to kinematic distances. A summary is made of comparison of H_2CO, H I and OH. For a given direction, these spectral lines generally have the same peak velocity. However, there were indications that the gases in a given absorbing cloud cannot be characterized by a single kinetic temperature and turbulent velocity. Relations between the H_2CO clouds and the H II regions are briefly discussed. Distributions of the H II regions and the H_2CO in the Galaxy made using the Schmidt (1965) model are presented. (auth)

43782 λ4686 He II LINE INTENSITY IN H II REGIONS AND THE COSMIC RAY FLUX. Peimbert, M.; Goldsmith, D. W. (Univ. de Mexico, Mexico City. Univ. of California, Berkeley). Astron. Astrophys.; 19: No. 3, 398-404(Jul 1972).

The λ4686 line of He^+ was detected in absorption in the continuum emission from the Orion Nebula; this result implies that most of the continuum emission in the Orion Nebula is produced by dust-scattered light as in reflection nebulae. Upper limits for the emission line intensities of λ4686 are presented. From these observations it is found that the $N(He^{2+})/N(H^+)$ abundance ratios are smaller than 1×10^{-4}, 1.05×10^{-4}, 1.4×10^{-4}, 4.4×10^{-4}, 4.5×10^{-4} for Ori I, Ori II, Ori III, M8 I and M17 I, respectively. The $N(He^{2+})/N(H^+)$ upper limits for the Orion Nebula imply that if the ionization of He^+ arises from cosmic rays, then the rate of primary ionization ξ_{pr} (He^+) is smaller than 1.4×10^{-12} s^{-1} in the case the cosmic rays are produced outside H II regions. If the cosmic-ray flux is produced inside H II regions it is found that O, B, flare, and T-Tauri stars produce a flux that is at least two orders of magnitude smaller than the flux needed to produce the intercloud medium ionization. The possible ionization of He^+ by x rays of energy ~100 eV was also considered. Because of the short mean free path of such x rays that arises from their ionization of He^+ one cannot set significant limits on the x-ray ionization rate outside H II regions from the upper limits on $N(He^{2+})/N(H^+)$. It is suggested that the $N(He^{2+})$ abundance in some H II regions in external galaxies might be due to cosmic-ray ionization. (auth)

Solar Phenomena

Refer also to abstracts 43044–43046, 43887, 43896, and 44472.

43783 (N–72–18798) CHARACTERISTICS OF MICROWAVE TYPE-4 RADIO BURSTS AND THE ACCELERATION OF SOLAR COSMIC RAYS. Sakurai, Kunitomo (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Feb 1972. 10p. (NASA-TM-X-65833; X–693-72-45). NTIS.

The relationships between some characteristics of microwave Type-IV radio bursts and solar protons of MeV energy are discussed. It is shown that the peak flux intensity of those bursts is almost linearly correlated with the MeV proton peak flux observed by satellites near the Earth. The rise times of Type-IV microwave emissions are, however, independent of the proton peak fluxes. Using these results, discussion is given on the acceleration process and duration for both protons and electrons. (auth) (STAR)

43784 NATURE OF THE FINE STRUCTURE OF THE CHROMOSPHERE. Pikel'ner, S. B. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 964-7 (May 1972).

Translated from Astron. Zh.; 48: No. 6, 1212-16(Nov 1971).

A basic component of the fine structure of the chromosphere, other than the spicules, is the thin, dark filaments or "fibrils" in active regions, and the corresponding fine mottles in undisturbed regions. These features are responsible for the complicated structure of the middle chromosphere at the limb. The fibrils are oriented along the magnetic tubes of force and are surrounded by the corona. Their gas is kept cool by the low heat conductivity across the lines of force—a magnetic shielding against conduction from the corona. Inside the magnetic tubes the thermal balance of the gas involves heating by waves; outside the tubes, both heating by waves and conduction from the corona. This last factor produces the sharp transition from chromosphere to corona and results in a thin transition layer, which sets in at a lower level than if heat conductivity were absent. As support for this interpretation, if one adopts a temperature of 10,000°K beneath the transition layer, and 18,000°K in the upper part of a filament, where the hydrogen becomes ionized, then the hydrostatic-equilibrium condition yields heights of 2000 and 3700 km for these two points, in agreement with observation. The thickness of the fibrils is governed by the balance between the external pressure of the corona and the internal magnetic pressure, which implies a field of $\approx$ 2 gauss and filaments of constant thickness. The optical depth in Hα, which determines the observability of the filaments against the disk, is calculated on the basis of excitation by electron collision and internal Ly-α radiation. The ionization is determined by collisions and by external ultraviolet radiation. Scattering of solar radiation accounts for the emission at the limb. Calculations show that fibrils should be observable at temperatures above 13,000°K. Above 18,000°K the hydrogen emission should disappear; such temperatures may occur in filaments at levels above 4000 km but below 7000 km, since the corona could not penetrate the filaments until the conductivity is high enough. The temperature in the fibrils will be stabilized by the emission of He II ions. (auth)

43785 MODEL FOR THE INITIAL (PREMAXIMUM) PHASE OF A CHROMOSPHERIC FLARE. Guseinov, R. E.; Imshennik, V. S.; Paleichik, V. V. (Inst. of Applied Mathematics, Moscow) Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 968-74(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1217-26(Nov 1971).

A model based on the theory of strong explosions is developed for the initial (premaximum) phase of a solar flare. A summary is given of the results obtained by solving the problem with allowance for all important dissipative processes. If the initial conditions are prescribed in dimensionless form, the problem has a unique solution, applicable in dimensional form for all values of the initial density and the flare energy. The high initial temperature of $\approx 10^8$°K at the center of the flare, the initial velocity of $\approx 10^8$ cm/sec for shock-wave propagation, and the values for the radius of the shock front and the front and plasma velocities agree satisfactorily with the observations. When a correction is introduced for radiation emission, the density and temperature profiles exhibit an oscillatory behavior due to thermal instability under dynamical conditions. It is important to recognize that the nonlinear development of thermal instability produces a rise in plasma density by several hundred times within a layer only a few hundred meters thick, accompanied by a sharp drop in temperature. Several new condensations might possibly be formed as the temperature falls behind the shock front. With any violation of spherical symmetry, these thin condensations could break into fragments, resulting in an intricate configuration with numerous condensations. The magnetic field would be enhanced in these condensations and would itself influence the configuration. An effort has thereby been made quantitatively to explain the filamentary structure of flares. (auth)

43786 DETERMINATION OF THE TURBULENCE VELOCITY IN THE SOLAR PHOTOSPHERE FROM PROFILES OF THE CN LINES. Porfir'eva, G. A. Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 975-9(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1227-31(Nov 1971).

The velocities of micro- plus macroturbulent motions in the solar photosphere were determined from the profiles of four lines belonging to the system of vibrational bands with $\Delta v = -1$ (the $B^2\Sigma^+ - X^2\Sigma^+$ electronic transition) of the CN molecule. Measurements were made at six distances from the center of the solar disk: $\sin\theta = 0, 0.7, 0.85, 0.90, 0.95, 0.98$. In the first approximation the turbulence velocity is independent of $\sin\theta$ and is equal to 3.5 ± 0.12 km/sec. (auth)

43787 RADIATION TEMPERATURE OF CO MOLECULES ON THE SUN. Sarychev, A. P. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 980-3(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1232-6(Nov 1971).

Under the conditions prevailing in the solar atmosphere, the source function for the vibration–rotation lines of the CO spectrum coincides with the Planck function. The temperature involved in the source function is called the radiation temperature T_{rad}. A method is described for determining a mean value of T_{rad} from measurements of line depths at different distances from the center of the disk. The CO layer is found to have $T_{rad} = 4720 \pm 160$°K, a value agreeing with recent measurements for CO of $T_{rot} = 4850 \pm 100$°K and $T_{vib} = 4800 \pm 250$°K. Thus the average temperature of the molecular CO layer on the Sun is about 4800°K. (auth)

43788 EMISSION OF THE λ4686 He II LINE IN QUIESCENT PROMINENCES. Morozhenko, N. N. (Central Astronomical Observatory, Kiev). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 984-9(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1237-43(Nov 1971).

An analysis of the excitation mechanism for ionized helium in quiescent prominences yields the following conclusions. 1. Low-temperature emission of the λ4686 He II line under the action of coronal ultraviolet radiation is possible only if the ionizing radiation can penetrate freely into a prominence whose electron concentration is close to 10^{10} cm^{-3}. The He I and He II lines would then have nearly the same half-width. 2. The λ4686 line can also be emitted under high-temperature conditions in the space between the filaments of a prominence, if T_e = 80,000 to 100,000°K and $n_e = 10^9$ to 10^{10} cm^{-3}. The half-width of the λ4686 line would then exceed that of the He I lines. (auth)

43789 FREQUENCY DEPENDENCE OF THE PERCENTAGE POLARIZATION OF TYPE III SOLAR RADIO BURSTS. Fomichev, V. V.; Chertok, I. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 990-4(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1244-50(Nov 1971).

An analysis of numerous measurements shows that the mean percentage polarization m of Type-III bursts remains approximately constant at ≈ 20% over the wide frequency range from 20 to 200 MHz. Some possible interpretations of this effect are discussed. The observed constancy of m(f) can be explained if the polarization of the radio emission in Type III bursts is ascribed to a difference in the escape heights of the ordinary and extraordinary waves. The magnetic-field strength would then have to decrease more slowly than r^{-3} with height in the corona above an active region. (auth)

43790 SOME PROPERTIES OF GROUPS OF TYPE III SOLAR RADIO BURSTS. Markeev, A. K.; Styazhkin, V. A.; Chertok, I. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 995-1000(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1251-7(Nov 1971).

The structural properties of Type-III events recorded as isolated bursts, transient groups (duration τ < 1 min), or persistent groups (τ > 1 min) were investigated, using observations made in 1967–1969 with the radio spectrograph of the Institute of Terrestrial Magnetism at 45 to 90 MHz. Type-III events develop a more complex structure as the importance classification of the associated flare increases. The structure also depends on the magnetic-field configuration in the corresponding sunspot group. Type-III events generated above unipolar spot groups and above spot groups having a complex field configuration show an enhanced representation of persistent groups of bursts, while events associated with bipolar spot groups have the greatest representation of isolated bursts. (auth)

43791 SOLAR FLARE TIME DEVELOPMENT: THREE PHASES. Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). Comments Astrophys. Space Phys.; 4: No. 3, 65-70(1972).

It is known that the development of a solar flare in time is not gradual. Instead, it is interrupted by periods of rapid, explosion-like changes in many flare characteristics. The three stages or phases in flare development are discussed: initial, explosive, and decay phases. (W.D.M.)

43792 TURBULENCE OF SOLAR PLASMA. Kaplan, S. A.; Pikel'ner, S. B.; Tsytovich, V. N. (Sternberg Astronomical Inst., Moscow). Comments Astrophys. Space Phys.; 4: No. 3, 71-8(1972)

Recent theoretical and experimental investigations have convincingly shown that turbulence is the usual state of the solar plasma. An up-to-date general picture of plasma turbulence in the upper layers of the solar atmosphere is presented. (W.D.M.)

43793 VALIDITY OF USING PRIMARY PARTICLES ONLY IN VAN ALLEN BELT AND SOLAR-FLARE PROTON SHIELDING STUDIES. Santoro, R. T.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 556-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43794 CLASSIFICATION OF TRANSITIONS BETWEEN LEVELS OF PRINCIPAL QUANTUM NUMBERS 3 AND 4 IN Fe IX TO XVI AND Mn VIII TO XV. Fawcett, B. C. (Culham Lab., Abingdon, Eng.); Cowan, R. D.; Kononov, E. Ya.; Hayes, R. W. J. Phys., B (London); 5: No. 6, 1255-69(Jun 1972).

$3p^n - 3p^{n-1}4s$, 4d, and $3p^n3d - 3p^n4p$, 4f transitions of Fe IX to XVI and Mn VIII to XV are classified through comparison of observed spectra with spectra computed using atomic self consistent field calculations. The required quality of observations was achieved by recording data during the short period when a theta pinch emitted spectra from the ionization stages under investigation. Accurate wavelength measurements in iron permit correlations to ±0.02Å with lines in the solar spectrum between 60 and 120Å. Observations of emission lines from these configurations were previously seriously deficient. (auth)

43795 PRECISION MEASUREMENT OF RELATIVE OSCILLATOR STRENGTHS. I. FUNDAMENTAL TECHNIQUE: A FIRST APPLICATION TO Mn I. Blackwell, D. E.; Collins, B. S. Mon. Notic. Roy. Astron. Soc.; 157: No. 3, 255-71(1972).

A discussion of the importance of accurate measurements of atomic oscillator strengths in astrophysics is followed by an analysis of the accuracy that is potentially available together with a critical survey of the most useful techniques. A full discussion is given of the furnace method used in Oxford, and first results obtained for a few lines of Mn I are presented. It is shown that the accuracy of even this straightforward method can in some circumstances suffer from uncertainties about the state of thermodynamic equilibrium. (auth)

43796 PHYSICS OF SOLAR PROMINENCES. REPORT ON AN INTERNATIONAL COLLOQUIUM HELD AT THE GERMAN SOLAR OBSERVATORY, ANACAPRI, SEPTEMBER 29 TO OCTOBER 1, 1971. Bruzek, Anton (Fraunhofer Institut, Freiburg i. B.); Kuperus, Max. Solar Phys.; 24: No. 1, 3-17(May 1972).

An international colloquium on physics of solar prominences was held at Anacapri, Sept. 29–Oct. 1, 1971. It was decided not to publish proceedings of the colloquium but to prepare a report to give a brief survey of the present knowledge on prominences by combining the main results, problems, and remarks as presented in the reviews, original contributions, and discussions. (54 references) (W.D.M.)

43797 FIRST ORDER ANALYSIS OF VARIATIONS OF THE LIMB DARKENING AND THE SHAPES FOR SOLAR FRAUNHOFER LINES. Athay, R. G. (National Center for Atmospheric Research, Boulder, Colo.); Lites, B. W.; White, O. R.; Brault, J. W. Solar Phys.; 24: No. 1, 18-27(May 1972).

New center-to-limb measurements in Fe I lines show changes in both the line profiles and the limb-darkening curves that appear to be characteristic of many other solar lines. Constraints placed on the atmospheric model by these effects are sought. It is found that, in addition to a depth varying source function, one must also allow the ratio of the continuous absorption coefficient to the total absorption coefficient to pass through a minimum in the mid-photosphere. Such an effect is consistent with inward increases of the Doppler width and damping constant in the upper photosphere and an inward increase of the ionization for both iron and hydrogen in the low photosphere. (auth)

43798 CHOICE OF BOUNDARY CONDITIONS FOR INTEGRATION OF TRANSFER EQUATIONS. Katz, J. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Irkutsk, USSR). Solar Phys.; 24: No. 1, 28-31(May 1972).

A method is described that makes it possible to choose the boundary conditions for the construction of the transfer equation solution. (auth)

43799 SOME NEW Dy II IDENTIFICATIONS IN THE SOLAR SPECTRUM. Howard, J. C. (Kitt Peak National Observatory, Tucson, Ariz.). Solar Phys.; 24: No. 1, 32-42(May 1972).

Extension of the identification of singly ionized dysprosium lines in the solar chromosphere and disk was made from a recently published laboratory analysis of the first and second spectrum. (auth)

43800 SPACE AND TIME VARIATIONS OF THE SOLAR Na D LINE PROFILES. Slaughter, C. D. (Kitt Peak National Observatory, Tucson, Ariz.); Wilson, A. M. Solar Phys.; 24: No. 1, 43-58(May 1972).

Preliminary results are presented of observations of the solar Na D lines obtained with high space and time resolution (2.4″ × 2.4″), (6 s). The following conclusions may be drawn: (i) The line profiles vary strongly with space and time implying that time averaging over a long period and large area will not produce the "true" profile. (ii) The center–limb increase in apparent Doppler width in the D lines is intrinsic. It is not due to space or time averaging. (iii) The amplitude of the 300-s oscillation may range up to 1.5 km/s in the region of formation of the D lines. Large line asymmetries are associated with this motion. Observations which do not resolve this motion can not be considered adequate. (iv) The variation of the D line profile caused by the 300-s oscillation may be described as follows: (a) The core is raised and lowered without change of shape. (b) The wings broaden as the central intensity rises and narrow as it falls. These variations are qualitatively explained by the scanning of the line formation region through the solar atmosphere. (v) Doppler width values derived from pairs of D line profiles are strongly correlated with the motion of the element observed. Hotter elements move upward, cooler downward. (vi) Indications of running waves have been found in the time variation of the core line bisectors. The profile variations observed provide a framework in which various properties of the center–limb variation of these lines may be considered. In particular, they show that any expectation of accuracy in profile coincidence above a certain value must be doomed by the intrinsic variability of the solar atmosphere. (auth)

43801 CHROMOSPHERE IN CONTINUUM EMISSION OBSERVED AT THE TOTAL SOLAR ECLIPSE ON MARCH 7, 1970. Makita, Mitsugu (Tokyo Univ.). Solar Phys.; 24: No. 1, 59-71 (May 1972).

Direct images of the Sun were photographed in continuum emission centered at 6900 Å by the jumping-film method near the second contact of the Mexico eclipse on March 7, 1970. The band width was 150 Å defined by a combination of a sharp cut filter and Kodak IV F film. The intensity distribution of the solar outer layers obtained shows a steep decrease by a factor of 0.9 in logarithmic units around 2500 km. This is interpreted as the boundary of the chromosphere and corona. Spicules observed at 3500 km are explained by log $n_e = 11.25$ and $T_e \approx 6000$ K. Discussions are made in relation to the other observations and some chromosphere models. (auth)

43802 TEMPERATURE OF THE HELIUM EMISSION REGIONS IN THE SOLAR ATMOSPHERE. Gulyaev, R. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Solar Phys.; 24: No. 1, 72-8(May 1972).

An analysis of the spectral distribution of intensity of the He I recombination continuum is probably the only direct method for determination of the electron temperature of helium emission regions on the Sun. On the basis of data on the He I Lyman continuum, obtained by Dupree and Reeves from OSO–4, the electron temperature of undisturbed helium regions is determined: $T_e = 12{,}500$ K. Such a low T_e value is a serious argument in favor of the predominant role of uv coronal radiation in the helium ionization on the Sun. Comparison of the He I Lyman continuum data with results of observations of the λ 10830 line showed that the visible helium lines and He I Lyman continuum are produced within the same regions of the undisturbed solar atmosphere at $T_e = 12{,}500$ K. (auth)

43803 Hα MOTTLES. Sawyer, Constance (National Oceanic and Atmospheric Administration, Boulder, Colo.). Solar Phys.; 24: No. 1, 79-86(May 1972).

Mottles located in the dark lanes that form the Hα chromospheric network are longer-lived than those that lie within network cells. The two groups of mottles are similar in size and shape. Bright mottles are found to be slightly larger than dark ones, with a different distribution of lifetimes, but no difference in shape or in number of mottles. Determination of mottle lifetime from the fraction surviving after various time intervals can give misleading results unless the time resolution is much smaller than the lifetime. Bhavilai's description of bright streaks is confirmed. (auth)

43804 INTENSITY OSCILLATION IN Hα-FINE STRUCTURE. Bhatnagar, Arvind; Tanaka, Katsuo (California Inst. of Tech., Pasadena). Solar Phys.; 24: No. 1, 87-97(May 1972).

Using a new technique of directly measuring the intensity variation from the 16-mm time-lapse filtergram movies taken in the blue wing and in the line center of Hα, periodic intensity oscillations in the center of Hα-supergranulation network, in rosette centers, and in plage granules were found. The oscillatory period of intensity in the network was of the order of 170 ± 44 seconds while in regions of stronger magnetic field, such as in plages and in rosettes, the period was found to be longer, on the order of 300 ± 50 seconds. It is suggested that observed intensity oscillation in the rosette center is related to the shooting out of dark mottles from rosettes. Oscillatory intensity fluctuations were also observed in the sunspot umbra. (auth)

43805 RELATIONS BETWEEN CHROMOSPHERIC FEATURES AND PHOTOSPHERIC MAGNETIC FIELDS. Frazier, Edward N. (Space Physics Lab., El Segundo, Calif.). Solar Phys.; 24: No. 1, 98-112(May 1972).

High-resolution photographic magnetograms were compared with Hα filtergrams (both on- and off-band) for a wide variety of solar features. It was verified that Hα filaments overlie neutral lines or bands and that Hα plages always occur at magnetic field clumps. However, the brightness of Hα plages bear no relation to magnetic field strength or polarity, and the direction of the magnetic field with respect to threads and filaments remains obscure. Counterexamples can be found for virtually every "rule" that has been formulated so far. Basic questions about the usefulness and final research goal of filtergrams and magnetograms are raised. It is shown that neither filtergram or magnetogram alone is capable of furnishing a unique solution. It is suggested that the proper direction for research is to use magnetograms, together with (as yet unspecified) additional sources of data, to understand Hα structures. (auth)

43806 EUV OBSERVATIONS OF THE CHROMOSPHERIC NETWORK. Reeves, E. M.; Parkinson, W. H. (Harvard Coll. Observatory, Cambridge, Mass.). Solar Phys.; 24: No. 1, 113-17(May 1972).

Extreme-ultraviolet observations of a quiet region of the Sun on August 18, 1969, with the Harvard spectroheliometer on OSO 6 indicate that the chromospheric network can be observed in lines of the chromosphere and transition region ($T = 8.4 \times 10^5$ K) with almost identical structure. At coronal heights, the network changes but some residual structure can still be discerned in Mg X and perhaps Si XII ($T = 2.3 \times 10^6$ K), although there is little or no evidence remaining in Fe XVI ($T = 3.5 \times 10^6$ K). (auth)

43807 RELATION BETWEEN FILAMENTS (PROMINENCES) AND Hα LOOPS. Bruzek, A. (Fraunhofer Institut, Freiburg i. B.). Solar Phys.; 24: No. 1, 118-22(May 1972).

The relation between occurrence of Hα loops and filaments is discussed on the occasion of the observation of a new type of transient loops during a flare-associated filament activation. Considering all known types of loop systems crossing neutral lines, it is concluded that concurrent existence of stable filaments and Hα loops is incompatible. (auth)

43808 VELOCITY FIELDS IN ACTIVE REGIONS. Howard, Robert (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Solar Phys.; 24: No. 1, 123-8(May 1972).

From line-shift observations in two spectrum lines, it is determined that the downward motions observed in plages may represent a real downward transport of material, not an apparent downward flow due to brightness or ionization differences in a multistream velocity model. (auth)

43809 POLARIMETRY IN SOLAR ACTIVE REGIONS. V. THE MAGNETIC FIELD IMMEDIATELY BEFORE AND AFTER A FLARE. Wiehr, E. (Univ., Goettingen, Ger.). Solar Phys.; 24: No. 1, 129-32(May 1972).

High resolved magnetograms (≈3″) were obtained 3 hrs before and 1 hr after a 1b flare, respectively, the only bright flare reported for that active region. Careful comparison between both magnetograms shows that the line-of-sight component of the active-region magnetic field remains constant. In particular, there is no simplification of the rather complicated field structure in connection with the flare. Magnetic flux and field gradients also do not show any variation above the 3″ scale. Essential changes, however, were observed after 19 hrs without flare activity. This indicates that evolutionary field changes predominate over "flare related" variations. (auth)

43810 POLARIZATION OF SOLAR ACTIVE REGIONS AT 9.5 mm WAVELENGTH. Kundu, M. R. (Univ. of Maryland, College Park); McCullough, T. P. Solar Phys.; 24: No. 1, 133-41 (May 1972).

A study of the circular polarization structure of solar-active regions was made from data obtained at 9.5-mm wavelength, using the 85-ft reflector and polarimeter at the Naval Research Laboratory Maryland Point Observatory. The angular resolution of the telescope at this wavelength is 1.6. All important active regions observed at 9.5 mm were bipolar in nature, the degree of polarization was about the same for both right and left circular components and it ranged up to about 4%. These oppositely polarized components corresponded with the Mt. Wilson magnetic regions of opposite polarity; the line of zero polarization delineated clearly the neutral line between the regions of opposite polarity on magnetograms. Unipolar regions in magnetograms also showed up as unipolar regions at 9.5 mm. Magnetic fields as low as 5 to 10 G on magnetograms manifested as distinctly polarized regions on 9.5-mm maps. A line of zero polarization seemed to delineate the extent of "absorption features" observed at 9.5 mm in coincidence with Hα dark filaments. (auth)

43811 SLOWLY VARYING COMPONENT SPECTRUM OF THE SOLAR RADIO EMISSION AT MILLIMETRE WAVELENGTHS. Efanov, V. A.; Kislyakov, A. G.; Moiseev, I. G. (Crimean Astrophysical Observatory, Moscow. Radiophysical Inst., Gorky, USSR). Solar Phys.; 24: No. 1, 142-53(May 1972).

The observed data on the solar S-component sources at millimetre wavelengths are considered. The observations were made in 1968 and 1969 using the 22-m radio telescope of the Crimean Astrophysical Observatory at six wavelengths: 2, 4, 6, 8, 13, and 17 mm. The enhanced intensity of the solar active region in comparison with the quiet Sun level varies proportionally to λ^{-2} if the wavelength λ is within the range of 2 to 6 mm. In the wavelength band of 6 to 17 mm almost flat spectra of the solar S-component sources is observed. Assuming the bremsstrahlung mechanism of the radio emission for the quiet Sun and the solar active regions an attempt was made to treat the above presented data. It appeared that the most probable explanation of the 2 to 6 mm spectrum is that the S-component sources are opaque. In the 6 to 17-mm wavelength band there are two possibilities: the active region may be either transparent or opaque. But in the last case the source brightness temperature must be proportional to λ^2. Some differences in the spectra of the sources, identified with flocculi and with bipolar sunspot groups, are mentioned. The cold regions (as compared with the quiet Sun) were observed up to λ = 2 mm and identified with the filaments. However, its visibility falls when the wavelength decreases. (auth)

43812 SPECTRAL ANALYSIS OF HIGHLY INHOMOGENEOUS CHROMOSPHERIC FLARES. Svestka, Z. (ESTEC, Noordwijk, Netherlands). Solar Phys.; 24: No. 1, 154-68(May 1972).

Analysis of a hydrogen flare spectrum is carried out, assuming that the flare radiation is diluted due to a highly inhomogeneous space distribution of the flare elements in the chromosphere. It is shown that one obtains the correct physical parameters in the flare elements, irrespective of the extent of dilution, if all the elements are optically thin in the spectral regions considered. However, if this is not true for all the elements, the parameters deduced are in error, which increases with the extent of dilution. The worst-affected parameter is the linear thickness of the flaring region which is found to be too low by a factor which may be as high as 10. Errors also enter into electron and atom densities which are found to be too high and into the column density of hydrogen atoms which is underestimated. On the other hand, the deduced source function and, in consequence of it, the electron temperature as well, remain unaffected, if the analysis is properly carried out. All the errors may increase strikingly if the analysis is performed for optically thick regions. Several kinds of observation are mentioned which indicate that dilution of radiation may occur in flares. However, reasonable estimates of the flare parameters are still possible provided that one avoids spectral regions with $\tau \gtrsim 1$. (auth)

43813 SOLAR FLARES IN THE EXTREME ULTRAVIOLET. I. THE OBSERVATIONS. Wood, A. T. Jr. (Harvard Coll. Observatory, Cambridge, Mass.); Noyes, R. W.; Dupree, A. K.; (and others). Solar Phys.; 24: No. 1, 169-79(May 1972).

Solar-flare observations in the extreme ultraviolet (300 to 1350 Å) are reported. Some 269 flares observed by the Harvard College Observatory (HCO) experiment on OSO 4 and 211 flares observed by the HCO experiment on OSO 6 were analyzed. The flares were observed in spectral lines and continua emitted by many ionic species over a temperature range from 10^4 to 3.5×10^6 K. The euv data were correlated with x-ray, Hα, and radio observations, and a significant number of euv bursts not associated with reported Hα, x-ray, or radio bursts were identified and investigated. The results indicate that these latter euv events are less energetic by about a factor of 2 than euv bursts associated with −F subflares. (auth)

43814 SOLAR FLARES IN THE EXTREME ULTRAVIOLET. II. COMPARISONS WITH OTHER OBSERVATIONS. Wood, A. T. Jr. (Harvard Coll. Observatory, Cambridge, Mass.); Noyes, R. W. Solar Phys.; 24: No. 1, 180-96(May 1972).

Extreme-ultraviolet (300 to 1350 Å) observations of nearly 500 solar flares from the satellites OSO 4 and OSO 6 were compared with data in x-ray and radio wavelengths. It was found that euv flares are closely associated with nonthermal x-ray and microwave bursts. The euv maximum intensity generally precedes the maximum intensity in Hα or soft x rays by up to several minutes. The euv e-folding rise time and peak intensity both depend on the x-ray burst characteristics. Nonthermal x-ray flares tend to be accompanied by strong, rapidly rising euv bursts, while thermal x-ray events are usually associated with weaker, more slowly rising euv flares. These relations are consistent with a picture of the flare in which the euv radiation is produced thermally in a region of high (chromospheric) density, which is being heated by collisional losses of the nonthermal electrons responsible for the impulsive x-ray and microwave burst. (auth)

43815 MODEL FOR DRIFT PAIR AND HOOK BURST EMISSION FROM THE SOLAR CORONA. Yip, W. K. (Univ. of Otago, Dunedin, New Zealand). Solar Phys.; 24: No. 1, 197-209(May 1972).

Combination scattering of the Cherenkov plasma waves generated by a fast electron beam on the electron-density fluctuations in a magneto-active plasma is assumed to be the cause of the emission of the drift pair (or the hook burst) from the solar corona. The features of the combination emission are studied numerically with parameters appropriate to the solar corona condition. It is found that the major properties of the drift pair and the hook burst can be accounted for. (auth)

43816 FREQUENCY SEPARATION IN STRUCTURE OF SOLAR CONTINUUM RADIO BURSTS. Rosenberg, Hans; Tarnstrom, Guy (Univ., Utrecht). Solar Phys.; 24: No. 1, 210-14 (May 1972).

A plot of frequency separation in fine structure in solar-continuum radio bursts against emission frequency indicates that the frequency structure cannot represent local proton plasma frequency modulation. However, the observations are consistent with the interpretation of the frequency structure as harmonics of the local electron cyclotron frequency and lead to reasonable estimates of the ratio between magnetic and kinetic pressures in stable coronal magnetic field configurations producing continuum radio sources. (auth)

43817 RESULTS OF OBSERVATION OF SPECTRA AND POLARIZATION OF METER SOLAR RADIO EMISSION WITH HIGH TIME RESOLUTION: MAY–JUNE, 1969. Chernov, G. P.; Chertok, I. M.; Fomichev, V. V.; Markeev, A. K. (IZMIRAN, Moscow). Solar Phys.; 24: No. 1, 215-32(May 1972).

Simultaneous observations of spectra and polarization of two noise storms with high-time resolution were performed in IZMIRAN during the periods: May 17−23 and June 7−13, 1969. The results of the analysis showed that, for different noise storms, Type-I bursts and chains of Type-I bursts possess different spectral and polarization characteristics and different tendencies in variation of these characteristics from day to day. In particular, the first stage of the noise storm in May presented some Type-I bursts that displayed a varying degree of polarization within their individual lifetimes. In addition, 112 Type-III bursts with weak or moderate polarization were observed. (auth)

43818 TEMPORAL DISTRIBUTION OF TYPE IV BURST-ACTIVE CENTERS OVER THE SOLAR CYCLE. Krueger, A.; Trinkkeller, B. (Central Inst. for Solar-Terrestrial Physics, Berlin). Solar Phys.; 24: No. 1, 233-5(May 1972).

It is concluded that: (1) nonrandom distributions of individual Type-IV bursts appear to be due to the effect of repeating of burst occurrences in special active centers, and (2) Type-IV burst-active centers appear to be mainly randomly distributed during the main part of the solar cycle. A "normalization" of this distribution brings an over-compensation of the solar activity and, hence, introduces again a nonrandom influence. (W.D.M.)

43819 HYDROGEN AND HELIUM VELOCITIES IN THE SOLAR WIND. Ogilvie, K. W. (Goddard Space Flight Center, Greenbelt, Md.); Zwally, H. J. Solar Phys.; 24: No. 1, 236-42 (May 1972).

Examination of separately determined helium and hydrogen bulk speeds in the solar wind show these to be equal, both on time scales of 30 min and 3 min. Observations of two interplanetary shocks and 12 discontinuities show the changes in bulk speed across them to take place simultaneously for the two species. Observations made at times of high helium abundance following an interplanetary shock, and at times of observation of colliding streams in the plasma, confirm the conclusion that, if bulk speed differences between species occur, they do so very rarely. (auth)

43820 SIZE DISTRIBUTION OF TURBULENT ELEMENTS IN THE EARTH'S ATMOSPHERE. Greve, A. (Max-Planck-Institut fuer Radioastronomie, Bonn). Solar Phys.; 24: No. 1, 243-6(May 1972).

Solar scintillation measurements made by Wessely and Mitchell are used to derive the size distribution of turbulent elements in the Earth's atmosphere. Assuming a stationary state of the Earth's atmosphere, the production rate of the turbulent elements is calculated. (auth)

Galaxies

Refer also to abstracts 43719, 43722, 43763, and 43764.

43821 (N-72-17867) NEW MEASUREMENTS OF THE GALACTIC RADIATION SPECTRUM BETWEEN 200 KHz AND 2.6 MHz. Brown, Larry W. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Feb 1972. 10p. (NASA-TM-X-65820; X-693-72-16). NTIS.

The Goddard Space Flight Center radio astronomy experiment aboard the IMP-6 satellite has provided new data on the absolute spectrum of the galactic background radiation at frequencies between 0.2 and 2.6 MHz. The measurements were obtained both in the terrestrial magnetosphere and in interplanetary space. One of the primary investigations was the measurement of the low-frequency component of the galactic radiation. The main sources of error are considered to be the rms noise fluctuations of the receiver, the measurement of the dipole antenna impedance, and in the determination of the noise source used in the preflight calibration of the receiver system. Interstellar models are planned considering the ambient plasma. (STAR)

43822 (N-72-19881) COMPUTER EXPERIMENTS ON THE STRUCTURE AND DYNAMICS OF SPIRAL GALAXIES. Hohl, Frank (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Mar 1972. 52p. (NASA-TN-D-6630). NTIS.

The evolution of an initially balanced rotating disk of stars with an initial velocity dispersion given by Toomre's local criterion was investigated by means of a computer model for isolated disks of stars. It was found that the disk is unstable against very-large-scale modes. A stable axisymmetric disk with a velocity dispersion much larger than that given by Toomre's criterion was generated. The final mass distribution for the disk gives a high-density central core and a disk population of stars that is closely approximated by an exponential variation. Various methods and rates of cooling the hot axisymmetric disks were investigated. It was found that the cooling resulted in the development of two-arm spiral structures which persisted as long as cooling continued. An experiment was performed to induce spiral structure in a galaxy by means of the close passage of a companion galaxy. Parameters similar to those expected for M51 and its companion were used. It was found that because of the high-velocity dispersion of the disturbed disk galaxy, only a weak two-arm spiral structure appeared. The evolution of a uniformly rotating disk galaxy which is a stationary solution of the collisionless Boltzmann equation was investigated for various values of the initial rms velocity dispersion. It was found that the disk becomes stable at a value of the velocity dispersion predicted by theory. (auth) (STAR)

43823 ORIGIN OF THE GALACTIC X-RAY BACKGROUND. Sofia, Sabatino (Observatorio Cagigal, Caracas. Univ. of South Florida, Tampa). Acta Cient. Venez.; 22: No. 4, 124-5 (1971).

Calculations show that the galactic component of the background x radiation observed in the few-keV range may be produced by accretion of interstellar matter onto evolved objects, probably white (and black) dwarfs. (auth)

43824 STRUCTURE OF THE SUBSYSTEM OF NOVAE IN THE ANDROMEDA NEBULA. Sharov, A. S. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 1001-5(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1258-64(Nov 1971).

The structure of the nova subsystem in the Andromeda Nebula to a distance beyond 20 kpc from the center is discussed. The subsystem has a nucleus about 2.4 kpc in radius. At distances of 1 to 2.4 kpc the logarithmic space-density gradient in the R coordinate is 0.81. Beyond, out to 17 kpc, the subsystem constitutes a disk whose density falls off with a gradient of 0.16, a value similar to the gradient of the nova subsystem in our Galaxy in the solar neighborhood. (auth)

43825 RELATION BETWEEN THE MORPHOLOGY OF SPIRAL GALAXIES AND THEIR BASIC PARAMETERS. Polyachenko, V. L.; Synakh, V. S.; Fridman, A. M. (Novosibirsk State Univ., USSR). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 934-40(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1174-82(Nov 1971).

A heterogeneous system comprising two disks rotating at different angular velocities and having different densities and thermal velocity dispersions is adopted as a model for a spiral galaxy. Such a system will be unstable, with a strong hydrodynamic instability leading to the growth of spiral-shaped density perturbations. The conditions for growth of various types of spiral perturbations are examined. In particular, double-arm spirals or rings will form if the frequency of "sound" due to the thermal velocity dispersion of the stars in the spherical subsystem is equal to the characteristic frequency for gravitational contraction. Whether a ring or double-arm spiral is formed will then be determined by the density of the flat subsystem (a high density will correspond to a ring). In this situation certain modes other than m = 0, 2 can develop, but with much smaller growth rates. However, if the "sound" frequency far exceeds all the other characteristic frequencies, the instability growth rate will become practically independent of the mode number. It is suggested that Hubble's classification of galaxies be replaced by an arrangement in order of specific angular momentum, and a related hypothesis is offered for the origin of barred spirals. (auth)

43826 VARIATIONAL PRINCIPLE IN THE THEORY OF THE EQUILIBRIUM AND STABILITY OF ROTATING BODIES. Bisnovatyi-Kogan, G. S. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 941-5(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1183-9(Nov 1971).

The equation of equilibrium and a condition for stability against radial perturbations are derived for a disk and a cylinder, with allowance for rotation, thermal energy, and a magnetic field, by applying a direct variation of the energy—a quantity analogous to the energy of a conservative system in mechanics. An infinitely long cylinder of bounded radius is found to be stable if $(\partial \ln P/\partial \ln \rho)_S > 1$. The condition for stability of a disk against a general expansion or contraction is shown to be fully analogous to the corresponding condition for a cylinder. If thermal motions or a magnetic field are present, intermediate wavelengths could be unstable in the disk; this behavior might explain the small number of spiral arms in galaxies. (auth)

43827 COMPUTATIONAL MODELS OF GRAVITATIONALLY INTERACTING GALAXIES. Wright, Alan E. (York Univ., Toronto). Mon. Notic. Roy. Astron. Soc.; 157: No. 3, 309-33 (1972).

Numerical computations of the dynamics of interacting binary galactic systems are presented. It is concluded that the tails and bridges frequently observed can be explained in the majority of cases as a result solely of the gravitational interactions within the system. (auth)

43828 SOFT X-RAY EMISSION FROM INTERGALACTIC GAS IN THE NEIGHBOURHOOD OF THE GALAXY. Hunt, R.; Sciama, D. W. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 157: No. 3, 335-48(1972).

The gravitational influence of the Galaxy on a hypothetical Local

Group plasma, is shown to give rise to a flux of soft x rays which may already have been detected. The required parameters of the plasma are $n \sim 2$ to 5×10^{-4} cm^{-3} and $T \sim 2$ to 30×10^{5}°K. The predicted soft x-ray flux would vary systematically with the angle between the line of sight and the direction to the galactic center by a factor depending on T, but of order 4 in typical cases. The fraction of the radiation coming from distances closer than the Magellanic Clouds depends on T, and is calculated to exceed 75% for $T < 7 \times 10^{5}$°K. Recent preliminary observations scanning the Small Magellanic Cloud suggest that this fraction does exceed 75%. If the emitting gas contains a small admixture of heavy elements expelled by the Galaxy, soft x-ray lines might be detectable. For example, if the relative abundance of oxygen $\sim 10^{-2}$ of its solar value, the combined equivalent width of the 21.6, 21.8, and 22.1Å lines of O VII would ~10 Å for an emitting temperature $\sim 2 \times 10^{6}$°K. Equivalent widths are given for all the lines of possible interest, and their angular variations discussed. Finally the integrated soft x-ray flux from other clusters of galaxies is considered. (auth)

Cosmology

Refer also to abstracts 44129 and 44131.

43829 DYNAMICAL PARAMETERS OF GALAXY CLUSTERS AS A CONSEQUENCE OF COSMOLOGICAL TURBULENCE. Ozernoi, L. M. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 923-33(May 1972).
Translated from Astron. Zh.; 48: No. 6, 1160-73(Nov 1971).

A quantitative model for the formation of groups and clusters of galaxies is developed on the basis of concepts regarding the vortex nature of pregalactic structure. Aggregates of galaxies would have formed on scales such that the hydrodynamic time characterizing the turbulence at the recombination epoch ($z_{rec} \approx 1000$) was longer than the cosmological expansion time. As the Universe expanded, a Kolmogorov velocity spectrum (typical of ordinary steady-state turbulence in a viscid, weakly compressible fluid) could have become established on these scales, up to some maximum scale. If the vortical velocity spectrum is known, one can calculate the spectrum of irrotational velocities generated after recombination, as well as the spectrum of the corresponding small inhomogeneities, which would have comprised a "gas" of protogalaxies. The transformation of these inhomogeneities into galaxy clusters is determined by gravitational instability, which would have led to the growth of irrotational velocities and ultimately to the isolation of corresponding clusters. The larger the mass of the cluster, the later it would have become isolated. The chief dynamical parameters of the clusters (mean density or radius; velocity dispersion) are expressed in terms of the ratio of the cluster mass to the maximum mass of a galaxy, with a weak dependence on the cosmological deceleration parameter. Despite several idealizations in the quantitative treatment (neglecting dissipation of the turbulence; a rough criterion for isolation), the calculated parameters for clusters of galaxies agree rather well with observation. A qualitative examination of certain matters concerning the spatial correlation of metagalactic turbulence velocities provides an explanation of the relation between the mean density of a galaxy cluster and its morphological type. Estimates are obtained for the velocity dispersion of field galaxies, as well as the relative contribution of rotational and random velocities to the kinetic energy of a cluster. It would be interesting to verify observationally the prediction of this theory that the contribution of rotation to the equilibrium of a cluster diminishes as the mass of the cluster increases. (auth)

43830 ORIGIN OF THE LOW ENERGY DIFFUSE COSMIC X-RAY FLUX. Culhane, J. L.; Fabian, A. C. (University Coll., London). Nature (London); 237: No. 5355, 379-81(16 Jun 1972).

While only the gross features of the low-energy diffuse flux have been observed, it seems that a galactic component of diffuse soft x rays is required. Sources of this flux should be distributed about the galactic plane with a scale height similar to that of the hydrogen. X-ray production probably originates by interactions with gas. (auth)

43831 NONEXISTENCE OF BARYON NUMBER FOR BLACK HOLES. II. Bekenstein, Jacob D. (Princeton Univ., N. J.). Phys. Rev., D; 5: No. 10, 2403-12(15 May 1972).

In a previous paper it was shown that a static (nonrotating) black hole cannot be endowed with exterior scalar-meson or massive vector-meson fields. Here it is shown that the same is true for massive spin-2 meson fields. The above results are also extended to the case of a rotating stationary black hole. It is concluded that a black hole in its final (static or stationary) state cannot interact with the exterior world via the strong interactions which are mediated by meson fields such as the π (scalar), ρ (vector), and f (spin-2). A direct consequence of this is the impossibility of determining the baryon number of the black hole by means of exterior measurements alone. This results in the transcendence of the law of baryon-number conservation as originally predicted by Wheeler. All the above conclusions hold both in general relativity and in the Brans–Dicke theory. It is also shown that the result of Hawking, that stationary black holes are identical in general relativity and in Brans–Dicke theory, holds even when the effects of the strong interactions (of the stellar material out of which the black hole was formed) are taken into account. The final conclusion is that in both theories the Israel–Carter conjecture that "all stationary single-black-hole exteriors are of the Kerr–Newman type" holds even when the strong interactions are "turned on." (auth)

43832 COUNTS OF RADIO SOURCES. Longair, M. S.; Rees, M. J. (Cambridge Univ., Eng.). Comments Astrophys. Space Phys.; 4: No. 3, 79-93(1972).

Arguments are repeated which show that the counts of radio sources disagree with the predictions of all simple cosmological models in which the number of sources per unit co-moving volume is supposed to remain unchanged with epoch (source-conserving models), and with those of steady-state theory. (W.D.M.)

43833 FROM MENDELEEV'S ATOM TO THE COLLAPSING STAR. Wheeler, John Archibald (Princeton Univ., N. J.). pp 189-233 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).
From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The development of the basic principles of chemistry and physics is reviewed, beginning with the principles developed by Mendeleev. Six lessons from this history of relevance to the current problem of gravitational collapse are discussed. Application of the quantum principle to the predicted phenomenon of gravitational collapse, both at the level of a star and at the level of the Universe itself, leads to the conclusion that the dynamics of the Universe goes on in superspace. The mathematical framework of superspace, though understood in broad outline today, still requires some augmentation to accommodate the quantum fluctuations in the topology of space that seem so inescapable at the Planck scale of distances. (A.G.W.)

43834 BACKSCATTERING CAUSED BY THE EXPANSION OF THE UNIVERSE. Parker, Leonard (Univ. of Wisconsin, Milwaukee. Princeton Univ., N. J.). Phys. Rev., D; 5: No. 12, 2905-8(15 Jun 1972).

It is shown that in a Robertson–Walker space–time, expansion-induced backscattering of electromagnetic waves is rigorously absent, contrary to earlier expectations. The absence of backscattering is a direct consequence of the conformal invariance of the equations of motion, and therefore extends to neutrinos and gravitational waves. Any non-null observation of backscattering cuased by the expansion would indicate that there exists expansion anisotropy. (auth)

43835 SOME CONFORMALLY FLAT COSMOLOGICAL MODELS OF AXIAL SYMMETRY. Bondarenko, N. P.; Kobushkin, P. K. (Inst. of Theoretical Physics, Kiev). Dokl. Akad. Nauk SSSR; 202: No. 3, 558-9(21 Jan 1972). (In Russian).

The use of a conformally flat linear element in cosmology significantly facilitates the interpretation of light and radio signals. Cosmological models of a homogeneous isotropic universe encounter a series of difficulties and agree poorly with observable data. A special form of the anisotropic, nonhomogeneous models was examined, possessing a conformally flat linear element of axial symmetry based on the Robertson–Walker concept. A red shift in the spectra of distant sources in the model was related to a combination of the Doppler effect and the Einstein effect. (K.S.W.)

43836 GENERAL REVIEW AND SUMMARY: ASTROPHYSICAL COSMOLOGY. Aizu, Ko (Rikkyo Univ., Tokyo); Hayakawa, Satio; Sato, Humitaka; Taketani, Mituo. Progr. Theor. Phys. (Kyoto), Suppl.; No. 49, 1-10(1971).

Papers which discuss various cosmological problems on the basis of evolutionary cosmology and the latest knowledge of astrophysics are reviewed. A short history of cosmological studies in Japan is included. (W.D.M.)

43837 EVOLUTION OF THE EXPANDING HOT UNIVERSE. Sato, Humitaka; Matsuda, Takuya; Takeda, Hidenori (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), Suppl.; No. 49, 11-82 (1971).

Evolution of the expanding hot Universe is discussed from the point of view of astrophysical cosmology. The main effort is devoted to the theory of galaxy formation in connection with the physical state of matter and radiation in the early stage of the hot Universe. (auth)

43838 FORMATION OF PROTO-GALAXIES IN THE EXPANDING UNIVERSE: GRAVITATIONAL INSTABILITY. Nariai, Hidekazu; Tomita, Kenji (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), Suppl.; No. 49, 83-119(1971).

Recent investigations carried out mainly in Japan concerning the problems of gravitational instability and galaxy formation in the expanding Universe are summarized. The problem of gravitational instability is dealt with. The linear theory is formulated in the Lagrangian reference system and is developed also in the case of Brans—Dicke cosmology. The nonlinear behavior of various perturbations is treated, partly by extending Lifshitz's linear theory to the second order and partly by taking into account the full nonlinearity in the sense of Newtonian hydrodynamics in the expanding universe. The problem of galaxy formation is considered. As for an initial state of the Universe the existence of primordial turbulence is assumed and whether density perturbations can be raised by the turbulent motions at the stage $t \lesssim t_D$ (the decoupling epoch) is examined. The formation of a gravitationally bound system and its passage to the contraction phase, dividing the stage $t \gtrsim t_D$ into the three stages, i.e., the early stage (an expansion phase), the middle stage (the separation from general expansion and the subsequent contraction) and the later stage (dynamical processes of a supermassive object) is discussed. (auth)

43839 THERMAL INSTABILITY IN THE EXPANDING UNIVERSE. Kondo, Masaaki (Tokyo Univ.); Sofue, Yoshiaki; Unno, Wasaburo. Progr. Theor. Phys. (Kyoto), Suppl.; No. 49, 120-47 (1971).

In the expanding Universe, the thermal instability, if it occurs, can develop much more quickly than the gravitational instability and, therefore, may provide a possible mechanism to initiate the formation of galaxies. The general characteristics of thermal instability are discussed for nonequilibrium media with due regard to the ionization change and the optical depth effect of fluctuations. If the matter can be brought to a temperature high enough to ionize hydrogen after 10^7 years of the cosmic age, the energy loss from the matter becomes mainly due to the bound-free processes rather than Compton scattering and a thermal instability will be set up. Such a high temperature ($\sim 10^4$°K) is excluded in the thermal history of the expanding Universe even if the effect of hydrodynamic turbulence is taken into account, since the inverse Compton loss is extremely large just after the epoch of the recombination of hydrogen when the turbulence decays rather rapidly. There is, however, a possibility that the turbulent energy is stored in the magnetic field and in cosmic-ray particles at the epoch of hydrogen recombination and released later ($\sim 10^7$ years) when the inverse Compton loss becomes less efficient. (auth)

43840 COSMIC-BACKGROUND X RAYS. Hayakawa, Satio; Sugimoto, Dai-ichiro (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), Suppl.; No. 49, 148-80(1971).

Observations of the diffuse component of cosmic x rays are reviewed. Theoretical attempts of interpreting its intensity and spectrum in terms of the metagalactic origin of the diffuse x rays are discussed in the framework of evolutionary cosmology. The presence of the metagalactic diffuse x rays implies that the intergalactic space is transparent for x rays. Consequently, helium should be mostly ionized and the abundance of metallic elements should be smaller by a factor of about 10^{-4} than that of hydrogen. Difficulties are pointed out in accounting for the absolute intensity and a break of the energy spectrum at several tens of keV. The inverse Compton collisions of relativistic electrons with universal microwave photons and with infrared photons in the vicinity of infrared sources give too low values of the break energy. The bremsstrahlung and innerbremsstrahlung induced by cosmic rays in the metagalactic medium may contribute to the diffuse x rays if evolutionary effects are taken into account. The result is sensitive to the values of parameters and can hardly explain all features of the diffuse x rays, in particular their soft component. It is discussed that the cosmic rays are responsible for the heating of the metagalactic medium and, consequently, play an important role in the thermal history of the Universe. (auth)

43841 STRUCTURES OF MAGNETIC FIELDS IN THE UNIVERSE AND GALAXIES. Fujimoto, Mitsuaki; Kawabata, Kinaki; Sofue, Yoshiaki (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), Suppl.; No. 49, 181-227(1971).

Statistical analyses are made of ninety-eight polarized extragalactic radio sources with known redshifts and measures of the Faraday rotation. Distribution diagrams of the rotation measures and the redshifts reveal substantial contributions of a metagalactic magnetic field to the observed Faraday rotations for distant sources. The most probable direction of the metagalactic magnetic field is determined as $l = 110°$, $b = 15°$ by using sixty one radio sources of $|b| \geqq 35°$ selected out of the ninety eight where l and b denote new galactic longitude and latitude, and the polarized radio waves from the sources of $|b| \geqq 35°$ have comparatively small galactic Faraday rotation effects. It is concluded that a large-scale metagalactic magnetic field is uniform at least up to a distance of $z = 2$ and the field strength is 2×10^{-9} gauss if $N_e = 10^{-5}$ electrons cm^{-3} in the metagalactic space. Some upper limits on the amount of antimatter have been obtained from these results and it is concluded that the Universe up to $z = 2$ is largely deviated from symmetry with respect to matter and antimatter. The existence of metagalactic magnetic field and recent theories on formation of galaxies suggest that magnetic fields in the Galaxy and galaxies are due to the frozen-in nature of the metagalactic magnetic field in condensing protogalaxies. Magnetic field structures at the level of the Galaxy and galaxies are also discussed. A circular arm with elliptical cross-section is used as a model of the spiral arm, and it is shown that interstellar gas may flow in a helical path along the axis of the arm. Interstellar helical magnetic lines of force can be in a stationary state, if such noncircular (rolling) motions of gas are superposed on galactic rotation. On the basis of the λ21-cm line survey of galactic plane by Westerhout (1966, 1969) the dynamically postulated rolling motion was sought. Distribution diagrams of the rolling motion along the arm suggest that the helical magnetic field is generated where the rolling motion changes its magnitude rapidly along the arm. Magnetic field topologies in the Magellanic-type barred galaxy are investigated from a magnetohydrodynamical point of view and are compared with recently measured E-vectors of polarized starlight from the Large Magellanic Cloud. It seems very probable that a magnetized interstellar gas performs a large-scale circulation in the bar and magnetic lines of force are parallel to the stream lines. (auth)

43842 ATTENUATION OF X RAYS IN INTERSTELLAR SPACE. **Schocken, Klaus (Marshall Space Flight Center, Huntsville, Ala.). J. Appl. Phys.; 43: No. 8, 3575-7(Aug 1972).**

Using the cosmic composition of elements as given by Aller and utilized by Bell and Kingston, and the total photon interaction cross sections per atom of the elements as computed by Hubbell and collaborators, the x-ray interaction cross sections are computed for three cosmic mixtures over the range 1 keV (12.4 Å) to 1.5 MeV (0.008 Å). The results are compared with a formula given by Heiles. Approximate agreement exists between 10 to 20 keV. (auth)

Planetary Phenomena

Refer also to abstracts 44132 and 44472.

43843 STRONG BEAMING OF JUPITER'S NON-Io-RELATED RADIO EMISSION. Gruber, G. M.; Way-Jones, C. (Rhodes Univ., Grahamstown, S. Afr.). Nature (London) Phys. Sci.; 237: No. 78, 137-9(26 Jun 1972).

It is stated that, although Io's influence on Jupiter's decametric radiation has been known for some time, no effort has been made to distinguish between Io-related and non-Io-related radiation when analyzing the effect of declining probability of reception after opposition with the Earth. Such an analysis is presented, based on data obtained in 1960 to 1967 from the Boulder High Altitude records for the periods from roughly four months before to three months after opposition. Amongst findings, it appears that Io-related sources (IRS) radiate fairly constantly, whereas the non-Io related sources (NIRS) have a fairly sharp cutoff after opposition. The difference in the radiation characteristics of IRS and NIRS suggests that there are two compounds of Jovian decametric radiation. The IRS are fixed with respect to the Jovian magnetic field, that is, they rotate with the planet, and whenever the Earth enters the cone of emission decametric radiation is received. The NIRS, however, are fixed with regard to the Sun—Jupiter geometry, and it has been suggested that their non-Io-related radiation originates on the evening side of the Jovian planet and is triggered off by instabilities caused when the Jovian and solar magnetic field lines recombine. The sudden cutoff after opposition suggests that the mechanism responsible for the radiation produces a definite beam out of which the Earth moves at about the time of opposition. (UK)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 43820.

43844 CONCENTRATION DISTRIBUTION OF IONS IN THE IONOSPHERE AT A HEIGHT OF 600 km IN LOW AND MIDDLE LATITUDES. Ponomarev, V. N. Cosmic Res. (USSR) (Engl. Transl.); 9: No. 6, 811-16(1971).

Translated from Kosm. Issled.; 9: No. 6, 878-84(1971).

The features of the planetary distribution of ion concentration as measured with an ion sensor on the Kosmos-184 Earth satellite from a height of 600 km is detailed. An elevated concentration level was observed both at night and during the day in the regions around the equator. A secondary ion-concentration maximum was observed over each of the polar regions. (J.C.W.)

43845 SEASONAL, DIURNAL, AND MAGNETIC DEPENDENCE OF IONOSPHERIC SCINTILLATION AT 64° INVARIANT LATITUDE. Aarons, J.; Mullen, J. P.; Whitney, H. E. (Air Force Cambridge Research Labs., Bedford, Mass.). Planet. Space Sci.; 20: No. 7, 957-64(Jul 1972).

F-layer irregularities at the invariant latitude of 64° were studied by observing amplitude scintillations at 137 MHz of the synchronous satellite, ATS 3; observations were made from Narssarssuaq, Greenland. In the 2 yr of data analyzed (1968 to 1970) consistent seasonal effects were noted. Quiet-day winter records showed little diurnal variation. Quiet-day summer daytime values showed extremely low occurrence of scintillation. These seasonal patterns must be integrated into the model of the high-latitude irregularity region. The occurrence of high-amplitude fluctuations correlated sensitively with the magnetic index. Nightly means of scintillation index showed a positive correlation of 0.46 with night means of K_p. The autocorrelation function of the nightly scintillation index reveals that a long-time constant of several days exists for the irregularity pattern. During magnetic storms the time of maximum occurrence of scintillation shifts from the quiet day peak of 2200 to a peak between 0300 and 0500, when $K_p = 4$ to 9. The morphology of the irregularity region is becoming more evident with the addition of the seasonal pattern and the long-term consistency of the irregularities. (auth)

43846 OBSERVATIONS OF SCINTILLATIONS OF TWO SATELLITE BEACONS NEAR THE BOUNDARY OF THE IRREGULARITY REGION. Aarons, J.; Allen, R. S.; Whitney, H. E. (Air Force Cambridge Research Labs., Bedford, Mass.). Planet. Space Sci.; 20: No. 7, 965-72(Jul 1972).

By utilizing observations of the scintillations of two synchronous satellite beacons, ATS 3 and Intelsat II F 3, from the Sagamore Hill Radio Observatory, comparisons could be made for ionospheric characteristics at the boundary of the high-latitude irregularity region. When the propagation paths of both satellites traversed F-layer irregularities, a comparison could be made to determine the effect of angle of elevation on scintillation index. It was found that the observations of elevation angle dependence were in accord with the thin layer analysis of Briggs and Parkin (1963). Two other aspects of the morphology of the irregularity region emerged. (1) With a sub-ionospheric path spacing of approximately one hour of time, the mean difference in time of maximum fading was two hours. The two-hour difference corresponded to the time difference of the two paths at the conjugate points. (2) A three-day coherence to the scintillation activity was noted. The autocorrelation function fell to 0.45 with one day's delay for the large body of data, indicating a long time constant for the boundary-position morphology. (auth)

43847 SIMULTANEOUS F-REGION CONJUGATE POINT DAWN EFFECTS AT TWO MID-LATITUDE STATIONS. Lejeune, G. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France); Taylor, G. N. Planet. Space Sci.; 20: No. 7, 1061-75(Jul 1972).

Observations of F-region electron temperature (T_e) and concentration (N_e) made simultaneously by incoherent scatter radars at St. Santin (44.6°N, 2.2°E) and Malvern (52.1°N, 2.3°W) during a period covering conjugate point and local dawns on Jan. 29, 1969 are presented. The rate of rise and the maximum value of T_e are greater at Malvern than at St. Santin, and a series of changes in N_e and h_mF2, the same for both stations, is clearly initiated by the onset of conjugate point heating. It is shown that the initial effects are due to a heat flux from the exosphere, approximately the same at both stations. A simple model is developed, following the arguments of a previous paper (Bauer et al., 1970), that shows that the temperature differences are due to differences in local N_e. A discussion of the changes in N_e and h_mF2 shows that an enhanced diffusion rate and a plasma flux from the exosphere are both dominant at times, but that enhancement of the electron loss rate is probably not important. (auth)

43848 SOME DEPENDENCES BETWEEN THE YEARLY COURSES OF SOLAR ACTIVITY AND IONOSPHERE. Velinov, P. I. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 2, 189-92(1972).

Effects of maxima in solar activity on some processes in the solar–terrestrial space (particularly the ionosphere) are examined. The temporal distributions of extreme radio frequencies (164, 245, and 593 kHz) are analyzed and compared with solar frequencies for various periods in the interval 1948 to 1970. The changes in the number of sunspots are probably associated with changes in the energy exchange in the Sun–Earth space (global effect). The course of the geomagnetic index and the solar radio emission are discussed. It is concluded that, instead of looking for parallelism between solar activity and the ionosphere, it is more promising to look for a strong effect of sharp changes of solar activity in the 11-year cycle. (D.L.C.)

43849 ANNALS OF THE IQSY. VOLUME 6. SURVEY OF IQSY OBSERVATIONS AND BIBLIOGRAPHY. Stickland, A. C. (ed.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1970). 596p. $30.00.

A historical review of the IQSY program is given in Section I. In Section II, the IQSY data reviews include information of meteorology; geomagnetism; aurora; night airglow; vertical incidence soundings, results of absorption measurements; drift observations; topside sounder satellite data; solar activity; cosmic rays; stratospheric circulation; the falling-sphere method for upper-air density, temperature, and wind; chemical releases during the IQSY; the atmospheric density of molecular oxygen; technique manual for night airglow rocket measurements; results of ionospheric current measurements by sounding rocket during the IQSY; and electron density and temperature measurements in the ionosphere. A bibliography of 5,359 references is given in Section III. (J.C.W.)

43850 PARAMETRIC EXCITATION OF ELECTROMAGNETIC WAVES. Forslund, D. W.; Kindel, J. M.; Lindman, E. L. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett.; 29: No. 5, 249-52(31 Jul 1972).

Electromagnetic waves propagating along a dc magnetic field are shown to excite parametrically decay, purely growing, modulational and beat-wave instabilities. Particular attention is given to whistler parametric instabilities, including a discussion of their nonlinear development and saturation. (auth)

43851 PHOTO-ELECTRON ENERGY DISTRIBUTION AND HEAT INPUT TO THE ELECTRON GAS IN THE IONOSPHERE. Tolpadi, S. K.; Singh, R. N. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 5, 342-5(May 1971).

The photoelectron energy distribution in the F region of the ionosphere was investigated by studying in detail the production and loss mechanisms for photoelectrons. By using the concept of the critical energy E_c and critical height H_c, proposed by Dalgarno et al., Planet. Space Sci., 11: 463(1963), the heat input to the electron gas in the F region of the ionosphere was estimated. From this, the variation of the heating efficiency ηH with altitude was studied. The daytime variation of heat input is shown to be significant only at low altitudes. The concept of a normalized heating efficiency parameter (η) is introduced, and the possible use of this is indicated in the study of the solar cycle variation of heat input, which is found to be significant only at higher altitudes.(auth)

43852 PAPERS PRESENTED AT THIRD SEMINAR ON THE CAUSE AND STRUCTURE OF TEMPERATE LATITUDE SPORADIC E, LOGAN, UTAH, SEPTEMBER 13–15, 1971. Radio Sci.; 7: No. 3, 345-432(Mar 1972). (CONF-710960).

A separate abstract was prepared for each of 16 papers, grouped under the following topics as follows: (1) Radio-wave Observations, 3 papers; (2) Rocket Observations, 4 papers; and (3) Theories, 9 papers. (J.C.W.)

For abstracts of individual papers see: 43853–43868.

43853 COMMENTS ON THE FIRST INTENSIVE PERIOD OF OBSERVATION OF E_s IN EUROPE. Bossy, L. G. (Royal Meteorological Inst., Brussels). Radio Sci.; 7: No. 3, 347-50(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

More than twenty European vertical-sounding stations participated in an intensive period of observation of E, on June 15, 16, and 17, 1971. Results show that, using values of f_0E_s from this network, useful information can be obtained about the structure and movement of E_s clouds. (auth)

43854 FIFTY-MEGAHERTZ E_s, 1964–1970. Dyer, Patrick J. (Inst. for Telecommunication Sciences, Boulder, Colo.). Radio Sci.; 7: No. 3, 351-3(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

Using amateur signals in the 50-MHz band to indicate the presence of oblique-incidence E_s paths, the diurnal, seasonal, and magnetic relationships of the phenomena for the years 1964–1970 were examined. Summer double diurnal peaks were found along with "off-season" meteor shower influences. (auth)

43855 STRUCTURE OF SPORADIC E FROM A RADIO EXPERIMENT. Whitehead, J. D. (Univ. of Queensland, St. Lucia, Australia). Radio Sci.; 7: No. 3, 355-8(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

An ionosonde has been used to measure the ordinary and extraordinary critical and blanketing frequencies separately. While the results support the idea that transparent sporadic-E reflections occur from small volumes within the E region, it is likely that the plasma density even in these volumes is often less than that required to cause total reflection. The structure of sporadic E is probably as follows: the peak plasma frequency varies by roughly equal amounts above and below a mean value often by a megahertz or so, within a few kilometers. Some intense blobs cause total reflection; other small volumes of increased plasma frequency strongly scatter radio waves of somewhat greater frequency. (auth)

43856 SPORADIC-E FORMATION BY WIND SHEAR: COMPARISON BETWEEN OBSERVATION AND THEORY. Kato, S. (Kyoto Univ.); Aso, T.; Horiuchi, T.; Nakamura, J.; Matsuoka, T. Radio Sci.; 7: No. 3, 359-62(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

A comparison is made between observation and theory of simultaneously observed wind shear and electron density in the lower ionosphere. The observation was done by K–8–16 rocket flown from Kagoshima Space Center, Japan. The method of characteristics for time-dependent solution of the equation of continuity, which is a partial differential equation of the first order, was used. The calculation shows a remarkable consistency between the observation and the theory even in details. The results strongly support the wind-shear theory for sporadic-E formation. The solution suggests that the effective recombination rate is 10^{-8} cm^3 sec^{-1} as found from other ionospheric observations. (auth)

43857 SPORADIC-E AND WIND–PROFILE INTERRELATION OVER HAWAII. Smith, Lawrence B. (Sandia Labs., Albuquerque, N. Mex.); Wright, J. W. Radio Sci.; 7: No. 3, 363-6(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

Principal qualitative and semiquantitative expectations of the wind-shear theory of sporadic-E are stated, with special emphasis on the significance of observed time variations in deciding whether the theory is operative and whether the vertical-shear mechanism is dominant. Nine wind profiles and twenty-two sporadic-E observations made in Hawaii are examined in the light of these expectations and are judged to behave consistently with the wind-shear theory. (auth)

43858 ROCKET OBSERVATIONS OF SPORADIC-E LAYERS. Smith, L. G. (GCA Tech. Div., Bedford, Mass.); Mechtly, E. A. Radio Sci.; 7: No. 3, 367-76(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

The characteristics of midlatitude sporadic-E layers were observed using rocket payloads incorporating a probe and a propagation experiment. Layers below 120 km show evidence of preferred altitudes. The slopes of layers are within 1° of horizontal. The horizontal dimensions are deduced to be several hundred kilometers. Individual profiles of daytime layers show a range of shapes ranging from triangular to rectangular. The plasma frequency derived from the peak electron density in the layer is found to agree with the blanketing frequency given by the local ionosphere sounder. (auth)

43859 IONOSPHERIC WINDS AND VISCOUS DISSIPATION. Rosenberg, N. W.; Zimmerman, S. P. (Air Force Cambridge Research Labs., Bedford, Mass.). Radio Sci.; 7: No. 3, 377-80(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

Analysis of frequency distribution of vertical shear of horizontal winds is reported for 2000 samples obtained between 90 and 136 km. The distribution is independent of altitude when shears are normalized by dividing by limiting shears of .075 sec^{-1} below 110 km, decreasing to .035 sec^{-1} at 128 km. Associated vertical wavelengths are also altitude independent when normalized, with shortest wavelengths increasing from 3 km to 10 km at 136 km. The Richardson number, as a criterion of turbulence, shows that 7% of space/time samples below 110 km will permit turbulence to initiate, while no samples above 115 km will permit onset of turbulence. Viscosities (computed by Hines equation relating viscosity and limiting wavelength) are 30-fold greater than molecular at 90 km, approaching molecular above 115 km. The rate of deposition through viscous shear is 2000 to 4000 erg g^{-1} sec^{-1}, but 10% of the samples have a five-fold higher rate, which will significantly affect temperature profiles. The shears found are capable of increasing molecular ion and electron density to about 4×10^3 cm^{-3} from background ionization levels below 10^3 cm^{-3}, and to 2×10^4 cm^{-3} from backgrounds of 10^4 cm^{-3}. They cannot significantly enhance 10^5 cm^{-3} backgrounds. (auth)

43860 SOME RECENT WORK ON SPORADIC-E THEORY. Whitehead, J. D. (Univ. of Queensland, St. Lucia, Australia). Radio Sci.; 7: No. 3, 381-4(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

Recent developments in wind-shear theory and other midlatitude E_s theory, with a discussion of relevant experimental work, are given. The role of metallic ions and especially their production and loss is not understood. The gradient instability is specifically excluded from this discussion, though it is likely to be important. (auth)

43861 THEORY OF MIDLATITUDE SPORADIC E. Layzer, David (Harvard Univ., Cambridge, Mass.). Radio Sci.; 7: No. 3, 385-95(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

A discussion of the observed properties of midlatitude sporadic E leads to the conclusion that vertical redistribution of neutral ionization is the only mechanism by which long-lived metal ions can be concentrated into thin sheets extending over horizontal distances of several hundred kilometers. However, vertical ion transport occasioned by observed wind shears with vertical scales of a few kilometers fails to account for the vertical structure of E_s layers and their diurnal and seasonal variations. Experimental evidence indicates that, below 120 km, narrow layers of enhanced ionization coincide with abrupt changes in the magnitude and direction of the wind shear. These changes, marked by corners in the horizontal-wind hodograph, occur over vertical intervals of 100 meters or less. Two alternative physical interpretations of these quasi-discontinuities are discussed (earlier suggestion that they represent gravity shocks regarded unlikely): stable contact discontinuities, across which the temperature and density (but not the vertical component of velocity and not the pressure) change abruptly; very narrow ($\Delta z \simeq 10$ meters) sheets of very high shear ($dV/dz \simeq 0.1$ sec^{-1}). It is shown that in either case the layer could function as an effective ion trap. Strong and variable electric polarization fields, however, would interfere with the action of such a trap. Considerations related to the variable component of the polarization field provide a simple and straightforward qualitative explanation for the double-peaked diurnal variation of intense summertime sporadic E, its seasonal variation, and its negative correlation with magnetic activity. (auth)

43862 ATMOSPHERIC METAL ION CHEMISTRY. Ferguson, E. E. (National Oceanographic and Atmospheric Agency, Boulder, Colo.). Radio Sci.; 7: No. 3, 397-401(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

The role of metal ion chemistry in the atmosphere is briefly reviewed. The available relevant thermal energy binary and three-body reaction rate data are tabulated. The importance of a two-step hydration of metal ions is pointed out, first three-body association of metal ions to CO_2 (or possibly O_2 or N_2) followed by a fast binary "switching" reaction, $M^+ \cdot CO_2 + H_2O \rightarrow M^+ \cdot H_2O + CO_2$ that should be particularly effective for metal ion loss in the D region. (auth)

43863 WINDS IN E REGION. Whitehead, J. D. (Univ. of Queensland, St. Lucia, Australia). Radio Sci.; 7: No. 3, 403-4(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

It is important to determine whether regular tidal winds or irregular gravity waves dominate the transport processes in the E region. This depends on their relative amplitudes. The question became prominent when Chimonas [1971] claimed that "the dominant winds in the E region are the solar tidal winds." This was a misquotation from another source. The best estimates seem to be that gravity-wave amplitudes are rather greater than either of the major solar tidal wind amplitudes at E-region heights. Consequences of assuming otherwise are discussed. (auth)

43864 INFLUENCE OF THE TIDAL WIND SYSTEM ON THE FREQUENCY OF SPORADIC-E OCCURRENCE. Harris, R. D.; Taur, R. (Utah State Univ., Logan). Radio Sci.; 7: No. 3, 405-10(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

Sporadic-E (E_s) data from Japan were presented to show the temporal variations in sporadic-E blanketing frequency ($f_b E_s$), virtual height ($h' E_s$), and frequency of occurrence. Tidal winds were substituted into the wind-shear theory of E_s to calculate electron-density profiles and determine the influence of the tidal winds in the asymmetry of the E_s occurrence variation. Results showed that the tidal-wind model used was not strong enough to significantly influence the formation of molecular ion E_s layers, but that the winds did have the proper orientation to accumulate and layer metallic ions in the late afternoon. The role of metallic ions in afternoon E_s will have to be established. (auth)

43865 LUNAR INFLUENCES ON SPORADIC E. Tarpley, J. D. (National Oceanographic and Atmospheric Administration, Boulder, Colo.); Matsushita, S. Radio Sci.; 7: No. 3, 411-16 (Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

Studies of sporadic-E data have shown that both the altitude and density of E_s layers vary in lunar time. Possible sources of the lunar effect are motions of the E_s layer produced by the electrostatic field associated with the lunar ionospheric current system, and wind shears in the lunar atmospheric tide. From studies of lunar atmospheric tides and the lunar ionospheric dynamo, values of the electrostatic field and wind shear may be estimated. Simple models are used to determine the effects of these electric-field and wind distributions on E_s layers, and the results are compared with the observed lunar variations in E_s. (auth)

43866 CROSS-FIELD INSTABILITY FOR THE FORMATION OF SPORADIC E. Kato, Susumu (Kyoto Univ.). Radio Sci.; 7: No. 3, 417-23(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

The cross-field instability is an important process in the explanation of small-scale sporadic E. Differences in the theories presented by different authors are apparent. It is true that there is no one-to-one correspondence of each Fourier component of perturbation between the electric field and the electron density about the direction of the ambient density gradient. The question arises as to how to choose properly the perturbation in the ambient charge gradient; but the difficulty does not seem serious. Computer experiments using realistic perturbations are desirable for the final answer on this question. The short-circuiting effect along the geomagnetic field does not damp the electrical polarization with small transverse size, i.e., small east—west wavelength. The upper limit of this size is a few hundred meters. (auth)

43867 POSITION OF ELECTRON DENSITY MAXIMA WITH VERTICAL IONIZATION MOVEMENTS. Whitehead, J. D. (Univ. of Queensland, St. Lucia, Australia). Radio Sci.; 7: No. 3, 425-8(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

A common test of the wind-shear theory of sporadic E is to compare wind profiles with corresponding electron-density profiles. The relationship between the two measurements is not always obvious. The presence of electric fields and vertical movement of the wind profile has been suggested to account for this. However, it is shown that the position of electron-density maxima relative to the horizontal winds must lie in certain height ranges irrespective of electric fields or wind profile movements, provided these are steady. If the winds were suddenly to change, it would take time for the electron-density profile to change. The time constants involved are estimated. Thus it should be possible to say whether the experimental results are consistent with the idea that the electron-density profile is produced by the wind profile. (auth)

43868 THREE-DIMENSIONAL ANALYSIS OF THE CROSS-FIELD INSTABILITY IN THE IONOSPHERE. Sato, Tetsuya (National Oceanic and Atmospheric Administration, Boulder, Colo.); Tsuda, Takao. Radio Sci.; 7: No. 3, 429-32(Mar 1972).

From third seminar on the cause and structure of temperate latitude sporadic E; Logan, UT. (13 Sep 1971). See CONF-710960.

A three-dimensional linear analysis is made of the cross-field instability for a geometry in which the magnetic-field lines make an arbitrary angle with the direction of density gradient. A general formula of the growth rate is obtained for a perturbation over whose scale the background quantities do not change appreciably. After applying the formula to the lower ionosphere, it is found that the results of an earlier analysis [Tsuda et al., 1966] are recovered as a special case; that is, the present instability is a potential source of small-scale irregularities in the temperate-latitude E region, as well as in the equatorial E region. (auth)

43869 SODIUM EMISSION FROM THE ATMOSPHERE DURING A SOLAR ECLIPSE. Gadsden, M. (Aberdeen Univ., Scotland). J. Atmos. Terrest. Phys.; 34: No. 8, 1309-20(Aug 1972).

Observations of the D lines of sodium in the spectrum of the zenith sky during a solar eclipse are discussed and examined for the presence of atmospheric emission, both continuum (the "Ring effect") and line (dayglow). It is concluded that observational data indicate dayglow of an intensity approximately to be expected from reflection and scattering of penumbral light. Some indications of a change in the Ring effect during an eclipse are reported. Twilight observations of the sodium layer over southern Mexico are shown to lead to a derived layer height unexpectedly smaller than that seen at midlatitudes. (auth)

43870 D-REGION ELECTRON DENSITIES AND COLLISION FREQUENCIES FROM FARADAY ROTATION AND DIFFERENTIAL ABSORPTION MEASUREMENTS. Bennett, F. D. G.; Hall, J. E.; Dickinson, P. H. G. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 34: No. 8, 1321-35 (Aug 1972).

A rocket technique for measuring electron density and collision frequency in the lower ionosphere is described. Absolute values of electron density were determined by a radio propagation experiment, and detailed height variations were measured with a Langmuir probe. In the derivation of the collision-frequency profiles, a pressure profile was employed that was found from measurements of the absorption of solar Lyman-α radiation made on the same flight. The analysis of results from one such flight is described in some detail. The payload was launched from South Uist, Scotland on June 19, 1969 at a solar zenith angle of 44° using a Petrel rocket. Electron density and collision frequency profiles are presented. (auth)

43871 AIRGLOW FLUCTUATIONS AT 2.2 μ. Peterson, A. W.; Kieffaber, L. M. (Univ. of New Mexico, Albuquerque). J. Atmos. Terrest. Phys.; 34: No. 8, 1357-64(Aug 1972).

The OH airglow was observed in the infrared, from high-altitude sites, with a bandpass filter from 2.0 to 2.5 μ. An average spatial fluctuation of ±4% and an average time fluctuation of ±3% are found about the mean nightly level. The evening fluctuations are more pronounced than the morning ones. The brightness and fluctuations are such as to preclude ground-based observation of the zodiacal light with wide-band photometry at this wavelength. (auth)

43872 INTERPRETATION OF IONOSPHERIC RADIO DRIFT MEASUREMENTS. V. DEMONSTRATION OF THE POINT EFFECT IN TIME-AVERAGED CORRELATIONS AND DRIFT CALCULATIONS. Wright, J. W. (Environmental Research Labs., Boulder, Colo.). J. Atmos. Terrest. Phys.; 34: No. 8, 1365-78(Aug 1972).

Experiments are described that illustrate the point source effect in the time-averaged spatial cross correlation and also validate it in the determination of time-averaged mean drift velocities by the radio spaced-antenna method. The effect of asymmetries of the antenna array on the estimation of ionospheric drift velocities is incidentally demonstrated. (auth)

43873 DESCRIBING FUNCTION OF THE DIURNAL VARIATION OF $N_m(E)$ FOR SOLAR ZENITH ANGLES FROM 0 TO 90°. Muggleton, L. M. (Univ. of Edinburgh). J. Atmos. Terrest. Phys.; 34: No. 8, 1379-84(Aug 1972).

Use of the Chapman function, Ch (x, χ), to describe the diurnal variation of $N_m(E)$ or its proportionate parameter $(f_0E)^2$, is hindered by the fact that x varies with χ in a manner difficult to define. Therefore an alternative function is proposed with χ as the only parameter. It is well suited to computer-aided synthesis of f_0E and to seasonal studies of E-region ionization. The function is based on a solar cycle of published data from seven stations chosen to provide a wide distribution of latitude. (auth)

43874 REGRESSION-LINE STUDIES OF E-REGION SEASONAL ANOMALY. Muggleton, L. M. (Univ. of Edinburgh). J. Atmos. Terrest. Phys.; 34: No. 8, 1385-91(Aug 1972).

Regression analysis of the variation of the monthly-median value of $(f_0E)^2$ with χ ranging up to 90°, at observatories widely distributed in latitude, revealed the slope of the regression line as virtually constant (≈0.6) for all seasons and locations. The regression line gives the value of $(f_0E)^2_{\chi=0}$ for each month at each station, and provides a refined method of studying the E-region seasonal anomaly. (auth)

43875 COMPARISON BETWEEN OBSERVED AND NUMERICALLY CALCULATED ATMOSPHERIC GRAVITY WAVES IN THE F-REGION. Klostermeyer, J. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 34: No. 8, 1393-1401(Aug 1972).

In previous work (1972) the author described the numerical calculation of gravity-wave propagation in a thermospheric model. Here calculated perturbation profiles of the electron density, the ion velocity, and the ion temperature are compared with experimental data obtained from the Thomson scatter facilities in Arecibo (Puerto Rico) and Saint-Santin (France). There is good agreement between calculated and observed results indicating that the numerical solutions represent a realistic description of gravity-wave perturbations in thermospheric regions. (auth)

43876 SOME EFFECTS OF NEUTRAL WIND CHANGES ON THE LOW-LATITUDE F-REGION. Rush, C. M. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Atmos. Terrest. Phys.; 34: No. 8, 1403-9(Aug 1972).

Using the time-dependent continuity equation, the effects of changes in the phase of a diurnally varying neutral air wind on the ionization distribution in the low-latitude F region are assessed. It is seen that the time at which the Appleton anomaly disappears varies when the phase of the meridional neutral wind changes, with the anomaly persisting longer when the wind has its maximum poleward speed earlier in the day. At times when the anomaly is well developed (1200 to 2000 hr), the wind exerts little influence on its structure. Poleward of the anomaly, however, the dependence of the ionization distribution on the phase of the neutral wind is similar to that seen for the midlatitude F region. (auth)

43877 INFLUENCE OF SOLAR FLUX AND THE EQUATORIAL ELECTROJET ON THE DIURNAL DEVELOPMENT OF THE LATITUDE DISTRIBUTION OF TOTAL ELECTRON CONTENT IN THE EQUATORIAL ANOMALY. Walker, G. O.; Ma, J. H. K. (Univ. of Hong Kong). J. Atmos. Terrest. Phys.; 34: No. 8, 1419-24(Aug 1972).

From latitudinal profiles of total electron content obtained during the period of the diurnal maximum development of the equatorial anomaly for the northern winter of 1967/1968, evidence was found that supports the explanation of the anomaly in terms of Martyn's drift theory: (1) The total ionization under the anomaly crests correlates positively with the equatorial electrojet intensity; (2) On average, the time at which the total content crest reaches its most northerly latitude occurs about 1 hr after h_m reaches its maximum value a few degrees north of the magnetic equator; and (3) the latitude of the crest at maximum development, and h_m near the magnetic equator, both correlate positively with the daily solar flux. It was found that for (1) the best estimate of the electrojet intensity seemed to be that using a daily range of H near the magnetic equator, implying that the electrojet forms an integral part of the Sq current system. (auth)

Particle Kinetics and Trapping

43878 RADIAL PENETRATION OF A HOT PLASMA ASSOCIATED WITH A LARGE-SCALE ELECTRIC FIELD IN THE MAGNETOSPHERE, AND SOME RELATED PROBLEMS. Tamao, Tsutomu (Tokyo Univ.). Planet. Space Sci.; 20: No. 7, 973-96(Jul 1972).

The inward penetration of a hot plasma as an energy accumulation process for magnetospheric substorms, and some related topics are discussed. First, the possibility that the large-scale electric field within the magnetosphere is induced as a result of the macroscopic interaction of the magnetic-field disturbances in the solar wind with the magnetosphere is considered. It is emphasized that the associated problem is essentially time-dependent, and the change of the north—south component of the interplanetary magnetic field is interpreted as the incompressible Alfvén mode. Second, the problem of the inward penetration of the symmetric-distributed energetic particles by the enhancement of the asymmetric electric field is quantitatively studied, using the drift kinetic approximation method. Taking account of the nonlinear feedback effect of the asymmetric part of the particle distribution, the secular equation for the time development of the symmetric distribution function is obtained. Some numerical solutions of this equation are given as an application to the ring-current proton-penetration problem. For steady-state penetration, the Earth's rotational motion and the tailward stretching of the field lines are important to the resonant protons with energy of 1 to 10 keV. Third, interrelation between the coherent adiabatic large-scale dynamical motion of the plasma as an energy accumulation process, and incoherent stochastic resonant wave—particle interactions, are discussed in relation to the energy accumulation and relaxation processes. The adiabatic drift-instability condition, which would be satisfied in the front side of the penetrated proton ring current, is also considered. Finally, the possibility of runaway electrons in the topside ionosphere as a source of the magnetospheric electrons during the substorm is also considered, and the associated limiting flux intensity is estimated. (auth)

43879 MOTION AND DIFFUSION OF ENERGETIC PARTICLES IN THE OUTER ZONE. Kosik, J. Cl. (Division Mathematiques, Toulouse). Planet. Space Sci.; 20: No. 7, 1025-31 (Jul 1972).

The longitudinal changes in drift velocity and bounce period are obtained using two theorems on magnetic-flux conservation. As a consequence, radial diffusion due to pitch-angle scattering is derived. The use of the same analytical model enables the comparison of this process with radial diffusion due to compressions of the magnetosphere. The two processes are competitive for intermediate colatitudes. (auth)

43880 PERSISTENT PARTICLE ANISOTROPIES AND MAGNETOSPHERIC MODELS. Scholer, M.; Morfill, G. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Planet. Space Sci.; 20: No. 7, 1051-9(Jul 1972).

The influence of an interplanetary-particle anisotropy on the asymmetry of solar-particle entry into the magnetotail is analyzed in the diffusion, as well as in the reconnection, model. By time-dependent diffusion calculations with an asymmetric boundary condition in a cylindrical tail lobe, it can be shown that a north—south interplanetary anisotropy leads in the open, as well as in the closed, magnetosphere to essentially the same polar-cap structures when observed with a dawn—dusk polar-orbiting satellite. However, depending on the satellite orbit, an east—west interplanetary anisotropy can serve to distinguish between rival magnetospheric models. Comparison of the diffusion calculations with polar-cap measurements during an east—west interplanetary anisotropy, as presented in Morfill and Scholer (1972), shows a large discrepancy, whereas an open-tail model fits these observations best. (auth)

43881 SIGNATURES FOR SUBSTORM DEVELOPMENT OF THE GROWTH PHASE AND EXPANSION PHASE. Iijima, Takesi; Nagata, Takesi (Tokyo Univ.). Planet. Space Sci.; 20: No. 7, 1095-1112(Jul 1972).

The development of a polar substorm consists of two distinctly different phases; i.e., the growth phase lasting 1 or 2 hr prior to the well-defined breakup, and the subsequent expansion phase. The growth phase is characterized by a gradual development of the polar vortex-type current without remarkable current enhancement in the auroral belt (DP-2 field), and as the asymmetric growth of the low latitude field-depression in the evening—midnight—early morning sector (DRT field). After a distinct DP-2 and DRT fields, drastic changes occur in the substorm development and the expansion phase starts. The expansion phase is characterized by a rapid expansion of the auroral-electrojet disturbance (AEJ or DP-B field) in the high latitudes, and a rapid recovery of the field depression near the midnight meridian and the subsequent asymmetric development of the disturbance field in the low latitudes. Considering the close associations of the interplanetary magnetic disturbance field with the magnetospheric field and particle disturbances that have been confirmed by previous work, it may be concluded that the growth phase is the precursory excitation of the magnetospheric background and the energy-storage or the energy-conversion stage in the magnetosphere due to the nonequilibrium magnetospheric convection, while the expansion phase is the energy-diversion stage in the magnetosphere. The disturbance field in the growth phase is a nucleus-like, fundamental element for the substorm breakup and it is essentially different from the expansion phase disturbance in quality and in quantity. (auth)

43882 RATIO BETWEEN ELECTRON CYCLOTRON AND LANGMUIR FREQUENCIES IN THE EARTH'S MAGNETOSPHERE. Ivanov, K. G.; Shevnin, A. D. Cosmic Res. (USSR) (Engl. Transl.); 9: No. 6, 806-10(1971).

Translated from Kosm. Issled.; 9: No. 6, 873-7(1971).

The ratio between the electron cyclotron ω_H and Langmuir ω_P frequencies in the Earth's magnetosphere is considered, based on data on electron and ion densities from the satellites Alouette 1, Explorer 31, OGO 3, and OGO 5. Besides the regions having $\omega_H < \omega_P$, extensive regions having $\omega_H > \omega_P$ were detected at high geomagnetic latitudes (beyond the boundary of the plasmapause) and in the polar cap. The significance of this fact with regard to the problems of the anomalous electrical resistance of the magnetosphere is noted. (auth)

43883 LONG-TERM VARIATIONS OF THE PROTON SPECTRA IN THE INNER BELT. Savun, O. I.; Shavrin, P. I. Cosmic Res. (USSR) (Engl. Transl.); 9: No. 6, 817-21(1971).

Translated from Kosm. Issled.; 9: No. 6, 885-9(1971).

Data on the proton spectra in the inner belt for 1961—1966 have revealed the high stability of the spectra on drift shells with $H_{min} > 500$ km. At the same time there are variations in the proton spectra at low altitudes. The results of investigations at $H_{min} < 300$ km, obtained during the period 1961–1969, are presented. It is concluded that the data point to the existence of an approximately three- to four-fold variation of proton flux with $E_p > 60$ MeV during the solar cycle. (auth)

43884 INVESTIGATION OF THE ELECTRON SPECTRA IN THE INNER RADIATION BELT BY THE COSMOS-219 SATELLITE. Savun, O. I.; Shavrin, P. I. Cosmic Res. (USSR) (Engl. Transl.); 9: No. 6, 822-6(1971).

Translated from Kosm. Issled.; 9: No. 6, 890-5(1971).

Measurement of the electron spectra in April 1968 and a comparison with 1962–1966 experiments revealed a change in the shape of the inner-belt electron spectra. The 1968 electron spectrum was divided into two components: a soft one ($E \precsim 0.8$ MeV) and a hard one ($E > 0.8$ MeV). Integral and differential spectra of electrons with $E = 0.13$ to 15 MeV at $L = 1.2$ to 1.8 and the spatial distribution of electrons in the inner belt are illustrated. (auth)

43885 RADIATION ANALYSES FOR THE MANNED APOLLO LUNAR MISSIONS. White, T. T. (Manned Spacecraft Center, Houston, Tex.); Atwell, W.; Hardy, A. C. Trans. Amer. Nucl. Soc.; 15: No. 1, 558-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Solar Wind and Cosmic Ray Interactions

Refer also to abstracts 43046, 43108, 43869, and 44091.

43886 RELATIONSHIP OF INTERPLANETARY MAGNETIC FIELD STRUCTURE WITH DEVELOPMENT OF SUBSTORM AND STORM MAIN PHASE. Kokubun, Susumu (Tokyo Univ.). Planet. Space Sci.; 20: No. 7, 1033-49(Jul 1972).

Development of a polar magnetic substorm and the main phase of a magnetic storm is compared with magnetic variation in interplanetary space. It is confirmed, using AE indices, that a polar substorm is well correlated with the southward component, B_{zs}, of the interplanetary magnetic field. The hourly-value AE shows the highest correlation with B_{zs} of the preceding hour. It is also found in the ground magnetic data that the twin-vortex current system without enhancement of auroral zone current, called DP2 or SP, develops with southward changes in the interplanetary magnetic field before the expansion phase of magnetic substorm. In cases of magnetic storms following the ssc's, caused by interplanetary shock waves, developments of substorm and D_{st} are found to be highly correlated with B_{zs}. When B_{zs} is small for about one day after the interplanetary shock no appreciable geomagnetic activity follows the ssc even in cases where the increase in kinetic energy flux of the solar wind is fairly large. In cases of large magnetic storms, large B_{zs} changes are usually observed during several hours or more within a day after the ssc, accompanying the development of geomagnetic disturbances. (auth)

43887 ANNALS OF THE IQSY. VOLUME 7. SOURCES AND AVAILABILITY OF IQSY DATA. Stickland, A. C. (ed.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1970). 353p. $17.50.

Information on the stations and observatories that participated in the international enterprise, and summaries of the types of scientific data and other material that were obtained are presented. Section I sets out a complete list of the geographical locations of the stations during the two years of the IQSY, 1964–1965, with relevant geophysical data such as magnetic inclination, and a tabulated statement of the geophysical disciplines in which observations were made. Section II contains lists of rockets launched and of satellites and space probes in orbit during part or all of the period, with information on associated scientific experiments. Section III is a catalogue of material relevant to IQSY investigations available at the World Data Centers. Section IV is a guide to the contents of the complete series in the form of a short index to the type of material contained and a comprehensive cumulative index of authors. (J.C.W.)

PHYSICS (ATOMIC AND MOLECULAR)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 43909, 44467, 44553, 44568, and 44576.

43888 SECONDARY ION YIELDS NEAR 1 FOR SOME CHEMICAL COMPOUNDS. Benninghoven, A.; Mueller, A. (Univ., Cologne). Phys. Lett.; 40A: No. 2, 169-70(3 Jul 1972).

Absolute secondary ion yields from cleaned and oxidized metal surfaces (Mg, Al, V, Cr, Fe, Ni, Cu) and from silver surfaces covered with different anions ($-Cl$, $-CN$, $-NO_3$, $-SO_4$) were measured. Yields near 1 were found for Al^+, V^+ and Cr^+ from oxidized metals and Cl^-, CN^-, NO_3^- and SO_4^- from silver surfaces. (auth)

43889 GENERAL DESCRIPTION OF K X-RAY DE-EXCITATION OF TITANIUM. Moore, C. F.; Senglaub, M.; Johnson, B.; Richard, P. (Univ. of Texas, Austin). Phys. Lett.; 40A: No. 2, 107-8(3 Jul 1972).

Measurements of $K\alpha$ and $K\beta$ x rays induced by proton, alpha, and oxygen-particle beams from an electrostatic accelerator show a divergence from the normal x-ray spectrum as the nuclear charge of the incident beam increases. The results of these measurements are consistent with the explanation that the ion excitation produces multiple inner-shell electron vacancies, which in turn causes electronic-shell energy shifts. (auth)

43890 NONCHARACTERISTIC X-RAY BANDS PRODUCED IN TARGETS OF C, Al, Si, AND SOLID Ar BY ARGON IONS AT keV ENERGIES. Macdonald, James R.; Brown, Matt D. (Kansas State Univ., Manhattan). Phys. Rev. Lett.; 29: No. 1, 4-6 (3 Jul 1972).

The energy, width, and yield of noncharacteristic x-rays are reported from collisions of argon ions at energies from 25 to 200 keV with targets of C, Al, Si, and solid Ar. The x-ray band has a peak at ~1160 eV with a full width at half-maximum of ~700 eV for solid Ar targets and a peak at ~900 eV with a full width at half-maximum of ~300 eV for the other targets. The yield increases with ion energy and decreases with the target Z. (auth)

43891 STUDY OF A VERY HIGH POWER ELECTRON BOMBARDMENT SYSTEM IN VIEW OF DEVELOPING AN IONIZING DEVICE WITH AN AXIAL MAGNETIC FIELD. Lanteri, H.; Bindi, R.; Renucci, G. (Univ., Nice). Rev. Phys. Appl.; 6: No. 4, 425-32(Dec 1971). (In French).

The development and characteristics of a high-power electron bombardment system utilizing magnetic confinement of the electron beam are discussed: the object of the system is the ionization of atomic beams. An increase in the electron—atomic beam interaction volume is achieved together with ionization over the entire volume of the atomic beam. (auth)

43892 SECONDARY ELECTRON EJECTION FROM METAL SURFACES BY METASTABLE ATOMS. III. ENERGY AND ANGULAR DISTRIBUTIONS OF THE EJECTED ELECTRONS. Allison, W.; Dunning, F. B.; Smith, A. C. H. (University Coll., London). J. Phys., B (London); 5: No. 6, 1175-85(Jun 1972).

Measurements were made of the angular and energy distributions of electrons ejected from contaminated metal surfaces by impact of thermal-energy metastable rare gas atoms. Mechanisms are proposed to explain these observations and also the high values of secondary-emission coefficients previously measured. The secondary-electron yield was found to be approximately independent of the angle of incidence of the metastable atoms. Reflection coefficients for metastable atoms at contaminated metal and glass surfaces were found to be very small and no ion emission was observed. (auth)

43893 INNER SHELL IONIZATION OF SURFACE ATOMS BY ELECTRON IMPACT. Gerlach, Robert L.; DuCharme, A. R. (Sandia Labs., Albuquerque, N. Mex.). Surface Sci.; 29: No. 1, 317-23(Jan 1972).

Ionization spectroscopy was used to measure differential cross sections for inner-shell ionization of various elements (the K shells of C, N, O, and the $L_{II, III}$ shells of Mg, Cl, Cu) adsorbed on W(100). The cross sections decrease monotonically with primary energy after the threshold energy is reached. The theory of Burhop (Proc. Cambridge Phil. Soc., 36: 43(1940)) is applied, and the calculations are compared with the experimental curves. (D.L.C.)

43894 SECONDARY ELECTRON EMISSION FROM SCANDIUM, ERBIUM, SCANDIUM DEUTERIDE, AND ERBIUM DEUTERIDE UNDER DEUTERON BOMBARDMENT. Wurtz, J. L.; Tapp, C. M. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 8, 3318-24(Aug 1972).

Secondary electron emission under deuteron bombardment at normal incidence over the energy range 50 to 170 keV was measured for scandium and erbium metals and their deuterides. Electron yields reported for the metals were taken from surfaces shown by in situ Auger spectroscopy to have a minimum amount of contamination. The secondary ratio at 100 keV was measured to be 1.30 ± 0.05 for scandium and 1.43 ± 0.05 for erbium. Emission coefficients for the deuterides were measured after a moderate vacuum bakeout and are significantly higher than for the metals. (auth)

Atomic and Molecular Properties

Refer also to abstract 44081.

43895 VIBRATIONAL FORCE CONSTANT AND ELECTRON RELAXATION IN H_2 AND Li_2. Chandra, A. K.; Sundar, R. (Indian Inst. of Science, Bangalore). Chem. Phys. Lett.; 14: No. 5, 577-82(1 Jul 1972).

The force constants of H_2 and Li_2 are evaluated employing their extended Hartree—Fock wave functions by a polynomial fit of their force curves. It is suggested that, based on incomplete multiconfiguration Hartree—Fock wave functions, force constants calculated from the energy derivatives are numerically more accurate than those obtained from the derivatives of the Hellmann—Feynman forces. It is observed that electrons relax during the nuclear vibrations in such a fashion as to facilitate the nuclear motions. (auth)

43896 PERIODIC TABLE INTERPRETED FROM ATOMIC SPECTRA. Moore-Sitterly, C. (National Bureau of Standards, Washington, D. C.). pp 163-88 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The relationship between atomic spectra and the organization of elements in the periodic system is reviewed. Vertical groups and horizontal groups in the periodic system are considered. Tables and diagrams are used to illustrate the relationships. A table summarizing identified atomic lines in the solar spectrum is included. (8 figures, 10 tables, 21 references) (A.G.W.)

43897 NEW THEORETICAL VALUES OF THE 2^3P FINE-STRUCTURE SPLITTINGS OF HELIUM. Daley, James (Univ. of California, Berkeley); Douglas, Marvin; Hambro, Lars; Kroll, Norman M. Phys. Rev. Lett.; 29: No. 1, 12-15(3 Jul 1972).

New theoretical values for the $2\ {}^3P$ fine-structure splittings in helium are reported. Comparison with experiment provides significant confirmation of the newly computed effects. (auth)

43898 MULTIPHOTON IONIZATION OF ATOMIC HYDROGEN IN THE PRESENCE OF AN INTENSE ELECTROMAGNETIC FIELD. Mohan, M.; Thareja, R. K. (Univ. of Delhi). J. Phys., B (London); 5: No. 6, L134-6(Jun 1972).

The matrix element for transition from ground state to final continuum state for atomic hydrogen in the presence of an intense electromagnetic field is calculated. (auth)

43899 USE OF THE STURMIAN FUNCTION FOR THE CALCULATION OF THE THIRD HARMONIC GENERATION COEFFICIENT OF THE HYDROGEN ATOM. Mizuno, J. (Queen's Univ., Belfast). J. Phys., B (London); 5: No. 6, 1149-54(Jun 1972).

The third harmonic generation coefficient of the hydrogen atom is calculated using the sturmian Coulomb Green function. The calculations of the nonlinear optical constants were stimulated by recent developments in laser physics. (auth)

43900 AUTO-IONIZATION STATES OF TWO ELECTRON ATOMS. Oberoi, R. S. (IBM Research Lab., San Jose, Calif.). J. Phys., B (London); 5: No. 6, 1120-5(Jun 1972).

Autoionization energies of He and H^- converging on the $n = 3$ and $n = 4$ hydrogenic thresholds are computed for states of several different symmetries by using the Feshbach formalism. Eigenvalues of the appropriate QHQ operator are determined by the Rayleigh—Ritz variational method. The trial wave function consists of an expansion in terms of the products of hydrogenic states and the exponentially decaying functions. Comparison is made with the experimental results and with other theoretical studies. (auth)

43901 APPLICATION OF THE MULTICONFIGURATION ENERGY BOUND METHOD TO THE FESHBACH-TYPE $^{1,3}P^e$ AUTOIONIZATION STATES OF He. Holoeien, E.; Midtdal, J. (Univ. of Oslo). J. Phys., B (London); 5: No. 6, 1111-19(Jun 1972).

The multiconfiguration energy-bound (MCEB) procedure was applied to Feshbach-type autoionization states with the $^{1,3}P^e$ symmetries of He. The calculations were performed in connection with an investigation of a possible extension of the MCEB procedure to include also the nonphysical intersections of roots originally belonging to different thresholds. The resulting curves exhibit only single minima. The nonrelativistic energies are given for some of the lowest-lying states of both symmetries pertaining to the n = 3 and n = 4 thresholds. The correct identification of the various curves is facilitated by the computed contributions to the total wave function from the different types of configurations. (auth)

43902 MANY-BODY GREEN'S FUNCTIONS FOR FINITE, NONUNIFORM SYSTEMS: APPLICATIONS TO CLOSED-SHELL ATOMS. Doll, Jimmie D.; Reinhardt, William P. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys.; 57: No. 3, 1169-84(1 Aug 1972).

Ab initio calculations of natural orbitals, ionization potentials, and total ground-state energies for the closed-shell systems helium and beryllium are given using the technique of many-body Green's functions. The necessary formalism for application of the Green's function theory to finite, nonuniform, many-body systems is developed following the work of Layzer; connections with standard perturbation theory are made. The natural orbitals obtained were of high quality. Analysis of the diagrammatic expansion of the Green's function led to the surprising result that the main effect of the infinite-order summations implicit in the solution of Dyson's equation was to "renormalize" the second-order perturbation corrections. (auth)

43903 AB INITIO CALCULATION OF HARMONIC FORCE CONSTANTS. VII. RESULTS FROM SOME TWO-ELECTRON SCF WAVE FUNCTIONS. Macias, A. (Univ. Autonoma, Madrid). J. Chem. Phys.; 57: No. 3, 1364-5(1 Aug 1972).

A simplification of previously derived (J. Chem. Phys., 56: 999 (1972)) formulas for calculation of force constants for totally contracted closed-shell self-consistent-field wave functions is presented. Force constants for H_2, He_2^{2+}, and HeH^+ calculated using 2 to 8 basis orbitals are tabulated. The value of the force constant is seen to improve as the basis set increases. (A.G.W.)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstract 44565.

43904 DIPOLE INTERACTIONS AND DIFFUSION OF μ^+ MESONS IN COPPER. Gurevich, I. I.; Mel'eshko, E. A.; Muratova, I. A.; (and others) (Inst. of Atomic Energy, Moscow). Phys. Lett. 40: A; No. 2, 143-4(3 Jul 1972).

The dipole relaxation rate and the diffusion coefficient of μ^+ mesons in copper are measured at different temperatures. The activation energy of μ^+ mesons in a crystal of copper is determined. (auth)

43905 HIGHER-ORDER VACUUM POLARIZATION CORRECTIONS IN MUONIC ATOMS. Sundaresan, M. K.; Watson, P. J. S. (Carleton Univ., Ottawa). Phys. Rev. Lett.; 29: No. 1, 15-18 (3 Jul 1972).

In view of the recently reported discrepancies between theoretical calculations and accurate experimental measurements of muonic x-ray energies for several elements in the energy range 150 to 440 keV, the vacuum polarization corrections were recalculated. The results reduce, but do not eliminate, the discrepancies. The effects of a possible anomalous coupling of the muon to a speculative scalar meson of the type suggested by Weinberg are discussed. (auth)

43906 STRONG INTERACTION EFFECTS IN THE 2p–1s TRANSITION IN PIONIC NEON. Eckhause, M.; Kane, F. R.; Kane, J. R.; (and others) (Coll. of William and Mary, Williamsburg, Va.). Nucl. Phys.; B44: No. 1, 83-92(1972).

Experimental results are presented for the 2p–1s transition energy and the natural linewidth of the 1s state in pionic neon. The linewidth $\Gamma = 14.5 \pm 3.0$ keV is in substantial agreement with semiphenomenological low-energy pion–nucleus interaction theories in the region $A \approx 20$. (auth)

Collision Phenomena

43907 (COO–1112-87) ELECTRON LOSS CROSS SECTIONS FOR FAST He–He COLLISIONS. Goldberg, Fred Marvin (Michigan Univ., Ann Arbor). 1971. 122p. Dep. NTIS. Thesis.

The electron-loss cross sections for He metastable (triplet and singlet) atoms and He ground-state atoms in He were measured in the energy range 2 to 5.5 keV with an atomic-beam apparatus. Since the metastable and ground-state electron-loss cross sections are considerably different, it is necessary to determine the beam composition in order to correctly interpret the observed cross sections. A fast He^+ beam was partially neutralized in either K vapor or He gas, and after the remaining ions were deflected away, the fast neutral beam entered a thin He stripping target. The apparent electron-loss cross section, σ_L^{App}, was determined from the dependence of the resulting fast ion current on the target density. σ_L^{App} was measured for two neutralizers where the corresponding values of the metastable fractions, f_x, were estimated to within reasonable confidence limits. The absolute values of the metastable, σ_L^M, and ground-state, σ_L^G, cross sections could then be separately determined. For a He neutralizer, where the capture into the ground state represents a symmetric resonant process, the value of f_{He} is assumed to be small. Analyzing the results of related experiments it was estimated $f_{He} = 0.014 \pm 0.008$. For a K neutralizer, capture into one of the n = 2 levels of He is nearly resonant ($\Delta E < 1$ eV), implying a large fraction of metastables. Arguments based on statistical weights and using the results of a measurement of the secondary emission coefficient (which is very sensitive to the fraction of metastables) give $f_K = 0.88 \pm 0.12$. In the energy range 2 to 5.5 keV, σ_L^M was found to be 10 to 40 times larger than σ_L^G, the ratio increasing with decreasing impact energy. The fractions of metastables formed in thin H_2, Ar, and N_2 neutralizers were also determined. Significant errors were introduced, however, by the small-angle scattering that accompanied the charge transfer. In the case of the H_2 neutralizer, the measured value for the metastable fraction was considerably larger than would be expected from other measurements at higher energies. (auth)

43908 (N–72-19758) DISSOCIATIVE EXCITATION OF VACUUM-ULTRAVIOLET EMISSION FEATURES BY ELECTRON IMPACT ON MOLECULAR GASES. III. CO_2. Mumma, M. J.; Borst, W. L.; Zipf, E. C. (Pittsburgh Univ., Pa. Dept. of Physics). Jan 1972. Contract DA-31-124-ARO(D)-440. 37p. (NASA-CR–125800; SRCC–162). NTIS.

Vacuum-ultraviolet multiplets of C I, C II, and O I were produced by electron impact of CO_2. Absolute emission cross sections for these multiplets were measured from threshold to 350 eV. The electrostatically focused electron gun used in this series of experiments is described in detail. The atomic multiplets produced by dissociative excitation of CO_2 and the cross sections at 100 eV are given. The dependence of the excitation functions on electron energy shows that these multiplets are produced by electric-dipole-allowed transitions in CO_2. (auth) (STAR)

43909 (RLO–1388-171) GAS–SOLID COMPARISON OF K X-RAY ENERGY SHIFTS PRODUCED BY 30-MeV INCIDENT OXYGEN IONS. Burch, D.; Swanson, H. (Washington Univ., Seattle. Dept. of Physics). 1972. 11p. Dep. NTIS.

X rays produced by 30-MeV oxygen-ion bombardment of Ar at various pressures and of Cl in the gaseous and solid states were measured. The fact that the energy shifts observed in both cases were found to be independent of the target density indicates that multiple inner-shell ionization takes place in the primary atom–ion collision and is not affected by a recoil interaction. The possibility of a simple statistical interpretation of the results is discussed. (A.G.W.)

43910 DRAWIN'S FORMULA FOR IONIZATION IN ATOM–ATOM COLLISIONS. Fleischmann, H. H.; Dehmel, R. C. (Cornell Univ., Ithaca, N. Y.). Z. Phys.; 252: No. 5, 435-42 (1972).

Drawin's semiclassical formula for ionization in collisions of neutral atoms or molecules is examined. Both from an analysis of its derivation and from a comparison with additional experimental data, it appears that considerable errors can be expected in general applications of this formula. (auth)

43911 VELOCITY DEPENDENCE OF THE SCATTERING AMPLITUDES IN RESONANT COLLISIONS. Zaidi, H. R. (Univ. of New Brunswick, Fredericton). Can. J. Phys.; 50: No. 11, 1175-81(1 Jun 1972).

The forward scattering amplitude for the two-body resonant collision is calculated as a function of the relative velocity. The interaction is assumed to be the long-range dipole–dipole, together with a short-range repulsive core. The quantum as well as semiclassical calculations are performed, and the validity of the existing calculations is discussed. Application of the results to the problem of resonance broadening is considered in detail. (auth) (Canada)

43912 ION–ATOM COLLISION CROSS SECTIONS AT 200 TO 3000 eV. Latypov, Z. Z.; Shaporenko, A. A. (Ioffe Inst. of

Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 117-23(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 151-8(Jan 1972).

An experimental apparatus for studying inelastic atomic collisions at 200 to 3000 eV is described. The method is based on the detection of the slow ions produced in a gas by the passage of a time-varying ion beam. The slow ions are extracted with the aid of a time-varying electric field. The pulses of the primary ion beam and the field used to extract the slow ions are displaced in time so that the slow ions are formed in the absence of the extraction field and extracted in the absence of the primary beam. The cross section is measured as a function of collision energy with a two-coordinate automatic recorder with continuous energy scanning, using a circuit for measurement of the ratio of the signal from the secondary ions to that from the primary incident ions with a fixed gas pressure in the collision chamber. The systematic errors are analyzed. (auth)

43913 PRECISION MEASUREMENT OF INELASTIC ENERGY LOSSES IN ATOMIC COLLISIONS. Afrosimov, V. V.; Gordeev, Yu. S.; Polyanskii, A. M.; Shergin, A. P. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 96-102(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 125-33(Jan 1972).

A method was devised for the analysis of inelastic energy losses in atomic collisions; the method is based on measurement of the kinetic energies of the two colliding particles and the use of a coincidence method. The kinetic energies of the particles are measured with electrostatic analyzers with adjustable resolution $\Delta T/T$ as good as 5×10^{-5}. The capabilities of the proposed method are compared with methods for measurement of inelastic losses in atomic collisions. It is shown that measurement of the kinetic energies of both particles makes it possible to achieve the highest energy resolution in analysis of inelastic loss spectra. This is the case since the components of the instrument function associated with thermal motion of the target-gas atoms and with the presence of several isotopes in the target are eliminated. (auth)

43914 IONIZATION OF N_2 AND CO BY 10-keV ELECTRONS AS A FUNCTION OF THE ENERGY LOSS. I. VALENCE ELECTRONS. El-Sherbini, Th. M.; Van der Wiel, M. J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 59: No. 3, 433-52(1 Jun 1972).

The small-angle inelastic scattering of 10-keV electrons in N_2 and CO was measured in coincidence with the ions and fragments formed. Continuous oscillator-strength spectra were obtained for the production of N_2^+, $N^+(N_2^{2+})$, CO^+, C^+, O^+, and CO^{2+}, via outer-shell excitations. Besides the onset of excitation to the X, A, and B electronic states of N_2^+ and CO^+ (which is observed as an increase in the oscillator strength), the N_2^+ spectrum shows that a considerable fraction of the oscillator strength goes to double electron transitions, i.e., to autoionizing Rydberg states converging to the C state. The formation of N^+ ions at the lowest threshold for dissociation is discussed with regard to earlier suggestions in the literature. In the case of N_2, the mass-14 spectrum (i.e., N^+ and N_2^{++}) clearly shows the contribution of N_2^{2+} formation at energy losses above 42 eV, while the structure in this range corresponds to onset of ionization to N_2^{2+} levels known from Auger-electron spectroscopy. The measurements of CO show that most of the doubly charged ions dissociate to C^+ and O^+ with lifetimes shorter than about 10^{-8}s. Comparison with optical measurements and electron-impact data shows the contribution to the total oscillator strength of fragment ions with excess energy of formation. (auth)

43915 IONIZATION OF N_2 AND CO BY 10-keV ELECTRONS AS A FUNCTION OF THE ENERGY LOSS. II. INNER-SHELL ELECTRONS. Van der Wiel, M. J.; El-Sherbini, Th. M. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 59: No. 3, 453-62(1 Jun 1972).

Oscillator-strength spectra are reported for the formation of N_2^+, $N^+ + N_2^{2+}$ and N^{2+} and CO^+, CO^{2+}, C^+, O^+, and C^{2+} following N_K excitation in N_2 and C_K excitation in CO. For promotion of a K electron to the first bound molecular level broad absorption bands ascribed to vibrational excitation are observed both in N_2 and CO. From a comparison with photoabsorption data it is inferred that the major fraction of K-ionization events leads to dissociation with excess kinetic energy of the fragments. No hydrogen-like jump is recorded at the K edges in N and C. Results obtained in Auger-electron and photoelectron spectroscopy, which are relevant for the present work, are discussed. (auth)

43916 DIFFERENTIAL CROSS SECTIONS IN THE ELECTRON IMPACT IONIZATION OF ATOMS AND MOLECULES. McConkey, J. W.; Crowe, A.; Hender, M. A. (Univ. of Windsor, Ont.). Phys. Rev. Lett.; 29: No. 1, 1-4(3 Jul 1972).

Angular distributions of ions produced in the electron-impact ionization of a number of atoms and molecules (He, Ar, H_2, N_2, CO_2 and NH_3) were measured for electron energies up to 300 eV. For He^+ and Ar^+ the ion distributions are found to mirror the "recoil" electron distributions of Ehrhardt and co-workers, thus confirming their explanation of their recoil peak. General trends in the angular distributions are summarized. (auth)

43917 ELASTIC SCATTERING OF POSITRONS BY ATOMIC HYDROGEN. Humberston, J. W.; Wallace, J. B. G. (University Coll., London). J. Phys., B (London); 5: No. 6, 1138-48(Jun 1972).

Kohn's variational method is used to calculate the positron—hydrogen scattering length and the x-wave phase shifts at several energies below the positronium formation threshold, and good agreement is obtained with the results of other recent variational calculations. A detailed analysis of the structure of the zero-energy wave function is made, and the wave function is used to calculate the electron—positron annihilation-rate parameter Z_{eff}, with the result 8.9, and the angular correlation of the two annihilation γ rays. The energy dependence of Z_{eff} is also investigated using the positive energy wave functions. (auth)

43918 MOMENT THEORY BOUNDS ON THE MEAN ENERGIES OF STOPPING, STRAGGLING, AND MOLECULAR EXCITATION. Langhoff, P. W.; Yates, A. C. (Indiana Univ., Bloomington). J. Phys., B (London); 5: No. 6, 1071-82(Jun 1972).

Quantum mechanical sum rules and results from the theory of moments are employed in the construction of rigorous upper and lower bounds on the mean energies of stopping, straggling, and molecular excitation appropriate for the passage of fast charged particles through matter. The bounds are constructed with effective excitation spectra chosen to satisfy known oscillator strength sum rules, in accordance with the dictates of the theory of moments, thereby circumventing the formally required spectral distribution of dipole oscillator strengths. Accurate results are obtained in the cases of atomic and molecular hydrogen and the inert gases with a minimum of computational effort, demonstrating that the moment theory approach for determining charged-particle mean penetration energies compares favorably with ab initio theoretical, semi-empirical, and closely related linear programming methods. (auth)

43919 EXCITATION CROSS-SECTIONS OF SEVERAL STATES OF HELIUM. Tripathi, D. N.; Sharma, V. N.; Rai, D. K. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 5, 290-2(May 1971).

Electron impact excitation cross sections of several states of helium atoms are calculated using various classical and empirical formulas and following the methods of V. I. Ochkur and M. Petrun'kin [Optics Spectrosc., N.Y., 14: 245(1963)] as well as the oscillator-strength method. A comparison of the values of cross sections calculated using the different formulas with the available quantal results [Ochkur, V. I. and Bratsev, V. E., Soviet Astron., AJ, 9: 797(1966)] shows that none of the formulas used reproduces the quantal results in the region of low-impact energy. The probable causes for the failure of the formulas to reproduce the quantal results are discussed. (auth)

43920 COMMENTS ON RUNDEL'S DISCUSSION OF PROTON PRODUCTION BY COLLISIONS BETWEEN ELECTRONS AND H_2^+. Dolder, K.; Peart, B. (Univ. of Newcastle-upon-Tyne, Eng.). J. Phys., B (London); 5: No. 6, L129-31(Jun 1972).

Rundel (1972) cast doubt on the accuracy of some theoretical and experimental cross sections for the production of protons by collisions between electrons and H_2^+ ions. Some reasons for rejection of Rundel's arguments are listed. (auth)

43921 VACUUM ULTRAVIOLET MEASUREMENTS OF THE ELECTRON IMPACT EXCITATION OF HELIUM. Donaldson, F. G.; Hender, M. A.; McConkey, J. W. (Univ. of Windsor, Ont.). J. Phys., B (London); 5: No. 6, 1192-1210(Jun 1972).

Total cross sections for the excitation of helium from its ground state to the 2^1P, 3^1P, and 4^1P levels by electron impact were measured in a polarization-free manner using a crossed-beam apparatus. The apparent excitation functions were cascade-corrected and made absolute using the optical oscillator strengths. The excitation functions exhibit shapes that differ from some other recent measurements particularly around the peak of the cross-section curves. Agreement at high energies between the measured total-cross-section values and the Bethe approximation is verified within experimental error. Comparison is made with the results of other workers and with the Bethe (1930) and Born approximations. (auth)

43922 INELASTIC ENERGY LOSSES IN ELECTRON TRANSITIONS IN Ne^+–Ne AND Kr^+–Kr COLLISIONS. Afrosimov, V. V.; Gordeev, Yu. S.; Polyanskii, A. M.; Shergin, A. P. (Ioffe Inst.

of Physics and Tech., Leningrad). Sov. Phys.-Tech Phys. (Engl. Transl.); 17: No. 1, 103-10(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 134-43(Jan 1972).

Simultaneous measurement of the kinetic energies of both atomic particles in a single collision event yields inelastic energy loss spectra and ionization spectra in strong Ne^+–Ne and Kr^+–Kr collisions. A discrete loss-spectrum structure is observed for both pairs of colliding particles when the nuclei approach to distances corresponding to overlapping of the inner electron shells. The energies and threshold linewidths of this structure are measured. Analysis of the inelastic loss lines associated with excitation of the outer shells of the interacting particles shows that ionization under strong-collision conditions occurs through formation of some general autoionized state characterized by a large number of excited electrons rather than from a series of independent single-electron transitions. The energies of the levels associated with excitation of the inner shell of the interacting particles confirm the hypothesis that vacancies are created in the inner electron shells in the collision. It is shown that experiment can be used to identify the terms of the quasi-molecular system formed in the collision; information can also be obtained on vacancy formation in the Fano model and on the internuclear distances at which the electron transitions take place. (auth)

43923 ELASTIC SCATTERING OF Li^+ IONS IN HELIUM. Inouye, H.; Kita, S. (Tohoku Univ., Sendai). J. Chem. Phys.; 57: No. 3, 1301-3(1 Aug 1972).

Repulsive potentials between a Li^+ ion and a He atom were derived from the experimental values of integral elastic scattering cross sections of the ions in the energy range of 500 to 4000 eV. The potentials are well represented by the following analytical expression: $V(r) = 428 \exp(-5.11\, r)$, $0.78 \le r \le 1.21$, where V(r) is in units of eV and r in angstroms. (auth)

Atomic Theory

Refer also to abstracts 44337 and 44338.

43924 FREQUENCIES OF RADIAL OSCILLATION AND REVOLUTION AS AFFECTED BY FEATURES OF A CENTRAL POTENTIAL. Powers, Robert T. pp 235-42 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

A parameter describing the classical orbit of a bound particle in a central potential is the ratio of the frequencies of radial oscillation and revolution. This ratio is proportional to the angle swept out by the particle between the apogee and perigee of its orbit. The effect of the form of the potential on this ratio of frequencies is studied for attractive central potentials that vary with a power of the distance from the center of force. The results of this study can be applied to quantum systems, such as the atomic elements, to obtain a qualitative picture of the effective potential as sampled by the outer electrons. (auth)

43925 ABOUT THE EXACT DEVELOPMENT OF ATOMIC AND MOLECULAR WAVE FUNCTIONS. Hertia, D. I.; Ivanov, Al. (Inst. of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 17: No. 4, 621-31(Apr 1972).

Some ways of writing the exact wave functions of N-electron systems are presented from a unitary point of view. It is shown that the form of the approximate wave functions used in some current quantum chemical calculations is justified through the existence of these exact series developments. The developments of the exact wave function into infinite series of products of mono-, bi-, or n- ($n < N$) electronic functions (the independent particles, pairs, or groups models) are corollaries of one and the same theorem connected with the spaces of functions with integrable squares. Hence, an expression of the type of that used by Sinanoğlu is rigorously derived, as well as the properties of its terms. (auth)

43926 SIMPLE, RADIALLY CORRELATED GROUND STATE WAVE FUNCTION FOR TWO ELECTRON ATOMS. Altick, P. L. (Univ. of Nevada, Reno). J. Phys., B (London); 5: No. 6, 1059-61(Jun 1972).

A one-parameter function is presented as an approximation to the ground-state wave function of the two-electron radial Hamiltonian. The parameter may be fixed by a nonvariational criterion. The resulting expectation value of the radial Hamiltonian differs from its exact eigenvalue by about 2 parts in 3000 for helium while the "local energy" never differs by more than 10% from the exact value over the entire $r_1 - r_2$ plane. The cases $Z = 1$ and $Z = 3$ are also investigated. (auth)

43927 EXACT EVALUATION OF CERTAIN PARTIAL SUMS OF THE SECOND ORDER ENERGIES OF ATOMS. I. THE GROUND AND THE SINGLY EXCITED STATES. Sharma, C. S.; Bowtell, G. (Birkbeck Coll., London). J. Phys., B (London); 5: No. 6, 1062-70(Jun 1972).

The second-order energy of an atom in an expansion in which the interelectronic interaction is treated as a perturbation can be written as a sum of certain partial sums. Each partial sum represents the contributions of the zero-order states originating from a fixed excitation of one electron and an arbitrary excitation of another electron. A method for the exact analytical evaluation of a certain class of such partial sums is developed. The relevance of the method to the calculation of the correlation energies in atoms is pointed out. The advantages and the disadvantages of the method in comparison with some other methods are discussed. (auth)

43928 APPROXIMATE SYMMETRY OF THE PERIODIC TABLE. Novaro, O. (Univ. of Mexico, Mexico City); Berrondo, M. J. Phys., B (London); 5: No. 6, 1104-10(Jun 1972).

An alternative form of building up the terms associated with different shells as they are successively filled in the atomic states of the elements of the periodic table is established. This "modified Aufbau procedure" requires fewer ad hoc assumptions than the $(n + 1, n)$ recipe. It furthermore allows one to relate the atomic magic numbers to the degeneracies of irreducible representations of a group built as the direct product of three SU(2) groups, making for a better theoretical understanding of the periodicity of the elements. (auth)

43929 EVALUATION OF MATRIX ELEMENTS OF SPIN-DEPENDENT OPERATORS FOR N-ELECTRON SYSTEMS. I. ONE-BODY OPERATORS. Cooper, Ian L. (Univ. of Newcastle-upon-Tyne, Eng.); Musher, Jeremy I. J. Chem. Phys.; 57: No. 3, 1333-42(1 Aug 1972).

The properties of the symmetric group are utilized to obtain a decomposition of matrix elements of spin-dependent operators into sums of products of space- and spin-dependent matrix elements. The Wigner–Eckart theorem is then applied, and an expression for the matrix elements in terms of reduced matrix elements in both space and spin and a set of coupling coefficients are obtained. The coupling coefficients and the reduced spin-matrix elements are evaluated for $N = 2, 3, 4$, and the corresponding reduced spatial matrix elements are evaluated in the simplest case of an orbital approximation. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

43930 (AE-447) ON THE ACTION OF A ROTATING MAGNETIC FIELD ON A CONDUCTING LIQUID. Dahlberg, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Mar 1972. 61p. Dep. NTIS (U. S. Sales Only).

A survey is presented of existing theories for the action of an applied rotating magnetic field on a conducting liquid in a circularly cylindric container. The treatment is mainly restricted to the z-independent case, which allows great simplifications but also limits the applicability. The solution for the magnetic field and the resulting forces is based on the condition that the velocity v be much smaller than ωc, the peripheral velocity of the applied field. Thus these results have a much wider applicability than the subsequent velocity calculations, which only treat the purely azimuthal laminar flow that should be unstable under most experimental conditions. The literature review shows much of the theoretical work to have had insufficient contact with the physical background. Experimental papers are scarce and tend to be too incomplete for proper evaluation. Standard torque measurements, although necessarily failing as an indicator of velocity characteristics, show the validity of force calculations. Typical velocities tend to be a few times the Alfvén velocity $B(\mu_0\rho)^{-1/2}$, which indicates that the electromagnetic forces are mainly balanced by inertial forces due to secondary flow. (29 references) (auth) (Sweden)

43931 SEARCH FOR A MAGNETIC FIELD DISTRIBUTION GENERATING A GIVEN TWO DIMENSIONAL VELOCITY PROFILE. Chambarel, Andre; Dorlhac, Francois (College Scientifique Univ., Avignon, France). Compt. Rend., Ser. A; 274: No. 12, 1005-7(20 Mar 1972). (In French).

The application of an external induction field to the flow of an electrically conducting fluid, in general, modifies the velocity distribution. The conditions under which the distribution of the corresponding magnetic induction can be deduced when a velocity profile is imposed are sought. (auth)

43932 UNSTEADY MAGNETOHYDRODYNAMIC FLOW DUE TO A POROUS ROTATING DISK. Srivastava, R. B. (Univ. of Lucknow, India). Compt. Rend. Acad. Bulg. Sci.; 25: No. 2, 177-9(1972).

The unsteady flow of a viscous incompressible fluid due to a rotating disk was studied by Pop (Compt. Rend. (Paris), 268: 228 (1969)). He considered angular velocity and suction velocity as functions of time. In this paper consideration is given to the effect of a transverse magnetic field when the fluid in Pop's problem is electrically conducting. (auth)

43933 TRANSIENT HYDROMAGNETIC FREE-CONVECTION FLOW. Rao, V. V. Ramana (Andhra Univ., Waltair, India). Indian J. Phys.; 45: No. 5, 233-5(May 1971).

The unsteady free convection flow of a viscous incompressible fluid past an infinite flat plate in a transverse magnetic field is studied, where the Prandtl number $P_m = 1$. (M.H.R.)

43934 MHD FLUCTUATING FLOW ALONG AN INFINITE FLAT WALL WITH VARIABLE SUCTION. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Indian J. Phys.; 45: No. 6, 250-61(Jun 1971).

An analysis of the fluctuating flow of a viscous, incompressible, electrically conducting fluid past an infinite porous plate under the action of a transverse magnetic field is presented under the following conditions: (1) variable suction, (2) the free stream velocity oscillates in magnitude but not in direction, (3) magnetic Prandtl number is unity, and (4) the Alfvén velocity is less than the suction velocity. Approximate solutions to transient velocity, magnetic field and current density are derived to $0(\epsilon)$ and are shown in figures. The amplitude and phase of the skin-friction and first and second harmonic of the temperature field are calculated. In the course of discussion, the effects of different parameters on the velocity and temperature field are set out. (auth)

43935 PROPAGATION OF CYLINDRICAL MAGNETOGASDYNAMIC SHOCK IN A NONGRAVITATING SYSTEM. Verma, B. G. (Univ. of Gorakhpur, India). Indian J. Phys.; 45: No. 6, 268-74(Jun 1971).

A cylindrical shock in a conducting gas produced by an explosion into an inhomogeneous nongravitating system is considered. Similarity principles were used to reduce the equations of flow to ordinary differential equations under the assumption that the density varies as an inverse power of distance from the axis of explosion. Further, by suitably choosing two auxiliary functions, analytic solutions of the problem were obtained. (auth)

43936 ALTERNATING-DIRECTION IMPLICIT NUMERICAL SOLUTION OF TIME-DEPENDENT, TWO-DIMENSIONAL, TWO-FLUID MAGNETOHYDRODYNAMIC EQUATIONS. Lindemuth, Irvin Raymond. Davis, Calif.; Univ. of California (1971). 198p. University Microfilms Order No. 72-17,912.

Thesis.

A very general method for solving numerically two-dimensional two-fluid magnetohydrodynamic equations is presented. The method uses second-order accurate alternating-direction implicit finite-difference equations. The accuracy and implicitness of the computer codes developed by the method are features not available in previously reported codes. In addition to selected hydrocode test problems, the method is applied to the study of the dynamics of a theta pinch and to the study of the trapping and thermalization of a laser-produced plasma expanding into a magnetic field. For the theta pinch, the effect of heat flow parallel to the magnetic field and the effect of axial motion are demonstrated. For the laser-produced plasma, the formation and persistence of the high-temperature shell observed in experiment is explained and a bounce radius and time at which plasma motion across the magnetic field ceases are predicted. The calculations reported display very strong two-dimensional phenomena, which cannot be demonstrated by the earlier one-dimensional approaches to the same problems. For all calculations, the implicitness of the method leads to enhanced numerical stability; the calculations were performed using time steps much larger than would be permissible with codes using explicit finite-difference equations so that a significant reduction in computer operating time was obtained. (Diss. Abstr. Int., B)

43937 MAGNETOHYDRODYNAMIC FLOW IN AN ANNULUS. Frazier, William Cortlandt. Philadelphia; Univ. of Pennsylvania (1971). 92p. University Microfilms Order No. 72-17,353.

Thesis.

The complete fluid-dynamic, magnetic-induction, and electric-current flow equations are derived for a liquid confined to an annulus and subjected to crossed magnetic and electric current fields. Axial symmetry is shown to be permissible, while time dependence must be maintained. The equations may be reduced in complexity by asymptotic considerations, resulting in a main region with adjacent boundary and corner regions. No solution for these equations is obtained. The flow appears to fluctuate, and qualitative observations indicate the flow may be turbulent in nature. A mixing-length approximation is performed for a tangential velocity distribution and, using velocity and wall stress measurements, the pressure near the top is predicted. Two empirical constants useful in the design of such devices are determined. (Diss. Abstr. Int., B)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 42967.

Electromagnetic

43938 (SLAC–147) SEARCH FOR UNKNOWN SOURCES OF NEUTRINO-LIKE PARTICLES. Rothenberg, Allan F. (Stanford Linear Accelerator Center, Calif.). May 1972. Contract AT(04-3)-515. 71p. Dep. NTIS.

A search was made, looking for new penetrating particles that could be made by a high energy electron beam striking a target. No evidence was found for such particles. There were ~100 events induced by high energy neutrinos. These event rates are consistent with the interpretation that the neutrinos came from the decays of π and K mesons produced in the target. We set a limit on any unknown source of penetrating particles that would interact in the detector: $\sigma_{\mathrm{prod}} f_{\Omega} \sigma_{\mathrm{int}} f_{\mathrm{tr}} < 10^{-70}$ cm^4, where σ_{prod} is the photoproduction cross section on a single proton, f_{Ω} is the ratio of the production solid angle to the detector's solid angle ($\approx 3 \times 10^{-3}$ sr), σ_{int} is the detectable interaction cross section per nucleon, and f_{tr} is the probability of transmission through the shield. Also a similar limit was set on any unknown source of a massive penetrating particle with a finite lifetime, $\gamma c\tau$ $e^{6.5\times10^3 \mathrm{cm}/\gamma c\tau} > 2.2 \times 10^{46}$ cm$^{-1}\sigma_{\mathrm{prod}} f_{\Omega} f_{\mathrm{tr}}$. (auth)

43939 ELECTROMAGNETIC INTERACTIONS OF HIGH-ENERGY COSMIC-RAY MUONS. Binns, W. R.; Kearney, P. D. (Colorado State Univ., Fort Collins). Nucl. Phys.; B43: 402-12 (15 Jun 1972).

The production of knock-on electrons and electron pairs by cosmic-ray muons was measured from cloud-chamber photographs of soft showers produced in lead and iron plates. The cloud chamber was located in a mine at a depth of 2.74×10^4 g/cm^2. Eighteen thousand muon traversals were recorded, about half in the lead plates and the remainder in the iron plates. The energies of the electrons that initiated the showers were obtained from experimental and theoretical shower curves. The observed number of events in 14 intervals of transferred energy, from 200 MeV to greater than 10 GeV, is compared with the theoretical predictions for knock-on electrons and direct pair production of electrons. In general, good agreement between theory and experiment is obtained for the sum of the direct pair and knock-on results in both lead and iron. From 1 to 5 GeV transferred energy, a small excess of events is observed for both the lead and iron data. From the dependence of the theoretical cross sections upon Z and A, this excess number of events appears to be due to the knock-on process. (auth)

43940 ANGULAR DISTRIBUTIONS OF PIONS FROM $\gamma + p \to \pi^+ + n$ AT PHOTON ENERGIES BETWEEN 220 AND 425 MeV. Fischer, G.; von Holtey, G.; Knop, G.; Stuempfig, J. (Univ., Bonn). Z. Phys.; 253: No. 1, 38-52(1972).

Earlier measurements of the differential cross section for π^+ photoproduction on hydrogen at forward angles were extended up to 180°. The pions were analyzed in angle and momentum by a magnetic spectrometer. Angular distributions were measured at 16 energies between 220 and 425 MeV. Most of them cover the region between 15 and 180° in steps of 5 degrees with a statistical error of about 3%. Moravcsik equivalent fits give a very good representation of the data. (auth)

Weak

43941 MEASUREMENT OF THE $\Delta \to \rho\mu^-\bar{\nu}$ BRANCHING RATIO. Baggett, M.; Baggett, N.; Eisele, F.; (and others) (Univ., Heidelberg). Z. Phys.; 252: No. 4, 362-70(1972).

A sample of 1.2×10^6 Λ-hyperons was analyzed in order to detect the rare decay mode: $\Lambda \to p\,\mu^-\,\bar{\nu}$. The Λ-hyperons were produced by stopping K^-- mesons in the 81 cm Saclay hydrogen bubble chamber at the CERN PS. For the branching ratio one obtained: $[\Gamma(\Lambda \to p\,\mu^-\,\bar{\nu})/\Gamma(\Lambda \to \mathrm{all})] = (1.4 \pm 0.5) \times 10^-$, based on 20 events, of which 6 have to be attributed to the background from the reaction $\Lambda \to p\,\pi^-$, $\pi^- \to \mu^-\,\bar{\nu}$. The background was determined by a Monte Carlo calculation. (auth)

43942 SEARCH FOR FINE STRUCTURE IN THE K^0_{L3} FINAL STATES. Clark, A. R. (Univ. of California, Berkeley). Nature (London); 237: No. 5355, 388-90(16 Jun 1972).

Reference is made to leptonic resonances, in which there is an interest as a result of both experimental and theoretical investigation. Anomalies in bubble chamber data have indicated a possible $\pi^\pm\mu^\pm$ resonance of mass ≈ 429 MeV and width <15 MeV in the final state of both $\nu p \to \pi\mu p$ interactions and $K^0_L \to \pi\mu\nu$ decays. Theoretical estimates of the effects of such a resonance were made, and it was suggested that the low measured limit on the rate for $K^0_L \to \mu^+\mu^-$ could be a consequence of an interpreting $\pi\mu$ intermediate state. Studies of finite quantum field theory with an indefinite metric suggest that leptonic resonances, if they exist, could be manifested in γe, πe, $\pi\mu$ and $\pi\nu$ channels. Data reported in this communication consisted of more than 100,000 analyzed $K_{\mu3}$ events and 200,000 K_{e3} events using a spectrometer originally designed to search for K^0_L decays into lepton pairs. Curves are presented showing the final $\pi 1$, $\pi\nu$ and 1ν mass spectra for the $K_{\mu3}$ and K_{e3} data; these are discussed, and the contributions from a $\pi\mu$ resonance are estimated. No leptonic resonances were found in the study of the K^0_L decays. (UK)

43943 EXPERIMENTAL STUDY OF THE DECAY MODE $K^0_L \to \pi^\pm\mu^\pm\nu$. Albrow, M. G. (Univ. of Manchester, Eng.); Aston, D.; Barber, D. P.; (and others). Nucl. Phys.; B44: No. 1, 1-20(1972).

In a study of 70,000 K^0_L decays, a sample of 9635 $K^0_L \to \pi^\pm\,\mu^\mp\nu$ candidates has been isolated. A study of the Dalitz plot is presented. The data is found to be in agreement with V-A theory and with other recent measurements of the parameters $f_+(q^2)$ and $\xi(q^2) = f_-(q^2)/f_+(q^2)$. The results are $\lambda_+ = 0.085 \pm 0.015$, $\xi(0) = -1.5 \pm 0.7$, $\lambda_- = 0.030 \pm 0.060$, $\Lambda = 0.15^{+0.17}_{-0.11}$, $\lambda_0 = -0.043 \pm 0.039$. The parameters are defined in the text. (auth)

43944 EXPERIMENTAL INVESTIGATION OF K^0 DECAYS. Bartl, W.; Neuhofer, G.; Regler, M.; Steuer, M. (Institut fuer Hochenergiephysik, Vienna). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II; 179: No. 8-10, 305-12 (1971). (In German).

Through a separated K^+ beam and the reaction $K^+_p \to K^0 p\pi^+$, a pure K^0 was produced. Momenta of electrons and pions were measured in a spectrometer and the electron was identified in a Cherenkov cell counter. Details of the experimental arrangement are presented as well as methods for determination of its efficiency. (H.B.G.)

Strong (Baryon-induced)

43945 (IFVE-STF–71-67) SLOW CHANGE OF THE TOTAL CROSS SECTIONS IN THE HIGH-ENERGY REGION. Ammosov, V. V.; Savrin, V. I.; Tyurin, N. E.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results on the quantitative analysis of the experimental data on the total cross sections in the energy region 7 to 65 GeV are presented. (auth)

43946 STUDY OF THE REACTION $\bar{p}n \to \bar{p}\pi^- p$ AT 7.0 GeV/c. Antich, P.; Carson, R.; Chien, C. Y.; (and others) (Johns Hopkins Univ., Baltimore). Nucl. Phys.; B43: 45-61(15 Jun 1972).

From a 3.5 eV/μb exposure of the BNL 80 inch chamber filled with deuterium to a 7.0 GeV/c $\bar{p}$ beam 664 events in the channel $\bar{p}n \to \bar{p}\pi^- p$ were obtained. The channel cross section is $(1270 \pm {}^{60}_{110})$ μb. The final state is dominated by $\bar{\Delta}(1236)$ production. The experimental data is well described by a one-pion exchange model with off-mass shell corrections. (auth)

43947 PROPERTIES OF PROTON–PROTON INTERACTIONS BETWEEN 100 AND 1000 GeV FROM A COSMIC-RAY EXPERIMENT. Jones, L. W. (Univ. of Michigan, Ann Arbor); Bussian, A. E.; Demeester, G. D.; (and others). Nucl. Phys.; B43: 477-521 (15 Jun 1972).

Proton-proton interactions above 100 GeV were studied in an experiment using cosmic-ray protons interacting in a liquid hydrogen target. From several hundred hydrogen interactions, it was learned that: (a) the total inelastic pp cross section is not changing significantly with energy above 30 GeV; (b) the multiplicity distributions of charged prongs agree with a Poisson distribution in charged-particle pairs; (c) the average charged prong multiplicity increases as ln s; (d) the angular distribution of charged particles agrees with a c.m. momentum distribution of charged particles that varies as $\exp[-8p_T^2 - 8x^2]\, d^3p/E$ (where $x = p_L/p_0$) and a nucleon distribution that varies as $10x \exp[-3p_T^2]\, d^3p/E$ for $0.05 < x < 0.85$. Further properties of the angular distributions, characteristics of the ionization calorimeter, the cross section in iron, and other features of the data are reported. (auth)

43948 STAR PRODUCTION BY HIGH-ENERGY HADRONS. O'Brien, Keran (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 15: No. 1, 555-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

43949 EVIDENCE FOR DECAYS OF THE D- AND E-MESONS INTO $\delta\pi$ IN $\bar{p}p$ ANNIHILATION AT 700 MeV/c. Defoix, C. (Collège de France, Paris); Do Nascimento, A.; O'Neal, J. S.; (and others). Nucl. Phys.; B44: No. 1, 125-41(1972).

A study is made of η^0 production in $\bar{p}p \rightarrow 3\pi^+3\pi^-\pi^0$ (7500 events) at an incident momentum of 720 MeV/c. The reaction is dominated by production of ω^0(≈68%). The η^0 production was studied by means of two independent methods: the first, a study of correlations between the $(4\pi)^\pm$ and $(5\pi)^0$ and the $(3\pi)^0$ systems, circumvents the problem of ω^0 reflections. The second attempts to isolate the $\eta^0 4\pi$ channel by means of rigorous selections using the decay properties of η^0 and ω^0. The results of the two methods are consistent and confirm the production of $\delta^\pm$, D^0 and E^0 with the decays $D^0 \rightarrow \delta^\pm\pi^\mp \rightarrow \eta^0\pi^+\pi^-$, $E^0 \rightarrow \delta^\pm\pi^\mp \rightarrow \eta^0\pi^+\pi^-$, $E^0 \rightarrow \eta^0\pi^+\pi^-$. (auth)

43950 PROPOSAL FOR ISOBAR PRODUCTION IN THE CERN STORAGE RINGS. Dibon, H.; Oberparleiter, R.; Regler, M. (Institut fuer Hochenergiephysik, Vienna). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II; 179: No. 8-10, 313-14 (1971). (In German).

Plans for experiments on the CERN storage rings are described. Differential cross sections for the reactions pp → $(n\pi^+)p$ (elastic-like) and pp → $(p\pi^+)n$ relative to the pp → pp cross section will be measured. A particle detector with parallel-arranged wires is being developed after the principle of a proportional counting chamber. Extensive experimental studies are under way which aim at the establishing of both optimal geometry and optimal gas filling. Especially studied are inert fluor and freon compounds. (H.B.G.)

Strong (Meson-induced)

Refer also to abstract 43906.

43951 A_1 AND A_2 PRODUCTION IN $\pi^-p \rightarrow \pi^-\pi^-\pi^+p$ AND $\pi^-p \rightarrow \pi^-\pi^0\pi^0p$ REACTIONS AT 7.0 GeV/c. Morse, R. (Univ. of Wisconsin, Madison); Oh, B. Y.; Walker, W. D.; Johnston, T. F.; Yoon, T. S. Nucl. Phys.; B43: 77-106(15 Jun 1972).

The A_1 and A_2 mesons as well as a $\rho\pi$ enhancement at 1230 MeV/c, the A(1230) are investigated. Both the A_1 and A(1230) appear as small signals on a large Deck background, and like the background are produced very peripherally suggesting a diffractive process. Their J^P are also consistent with diffractive production, the A_1 being $J^P = 1^+(l = 0,2)$ with non-negligible D wave, and the A(1230) being consistent with either a $J^P = 1^+(l = 0)$, or $2^-(l = 1)$ assignment. Further, our data is inconsistent with the A_1 being a kinematical enhancement as is sometimes asserted. Studying next the general characteristics of the non-resonant $\rho\pi$ background it is established to be mostly $J^P = 1^+(l = 0)$ with a small $J^P = 2^-(l = 1)$ component which becomes larger at higher $\rho\pi$ mass and Δ^2_{pp}. Finally, the $\rho^0\pi^-/\rho^-\pi^0$ ratio is found to be consistent with unity, the valve expected for an $I = 1$ $\rho\pi$ system for the $\rho\pi$ mass region of 1.1 to 1.4 GeV/c². The A_2 is next studied, and it is found to be a $J^P = 2^+$ object. Its non-peripheral production mechanism is qualitatively in agreement with ρ or natural parity exchange, and is quite different from the diffractive background on which it rides. The A_2 $\eta\pi$ decay is studied and it is separately established as a $J^P = 2^+$ object produced via natural parity exchange. The $\eta\pi/\rho\pi$ branching ratio of the A_2 is found to be 20%. (auth)

43952 STUDY OF THE REACTION $K^-p \rightarrow K^-\pi^-\Delta^{++}(1236)$ AT 8.25 GeV/c. Athens-Democritos-Liverpool-Vienna Collaboration. Nucl. Phys.; B43: 1-12(15 Jun 1972).

The reaction $K^-p \rightarrow K^-\pi^-\Delta^{++}$ was studied at 8.25 GeV/c in terms of the CLA model. Evidence for separate amplitudes including pomeron and K* exchange was found. Good agreement was obtained between the model and the data without the need for any terms involving resonance production in the amplitudes for the reaction. (auth)

43953 MEASUREMENT OF THE POLARIZATION PARAMETER IN π^+p BACKWARD ELASTIC SCATTERING AT 6 GeV/c. CERN-I. P. N. Orsay-Oxford Collaboration. Nucl. Phys.; B43: 522-40(15 Jun 1972).

The polarization parameter in π^+p backward elastic scattering at 6 GeV/c incident pion momentum was measured using a butanol polarized proton target, a high intensity pion beam, and a scintillation hodoscope detection system. Details of the apparatus and data analysis are presented here, together with the final results. The polarization appears to be very nearly zero for small u-values, but becomes large and negative for u-values beyond the dip in the π^+p cross section at $u = -0.15$ (GeV/c)². The data are not well predicted by any of the current Regge-exchange models. (auth)

43954 REACTIONS $K^+d \rightarrow K^+d$, $K^+d \rightarrow K^+pn$ AND $K^+d \rightarrow K^0pp$ AT 3 GeV/c WITH AN INVESTIGATION OF K^+n SCATTERING. Buchner, K. (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Dehm, G.; Geist, W.; (and others). Nucl. Phys.; B44: No. 1, 110-24(1972).

As a partial result of an analysis of K^+d interactions at 3 GeV/c produced in the 81 cm Saclay bubble chamber, data on K^+ differential cross sections are presented for the following reactions: $K^+d \rightarrow K^+d$, $K^+d \rightarrow K^+pn$, $K^+d \rightarrow K^0pp$. A set of parameters describing the K^+n elastic scattering was obtained from a simultaneous fit, based on the Glauber model, to the three experimental differential cross sections and to the K^+d total cross section, giving $\alpha_n = 1.7 \pm 0.5$ GeV^{-2} for the slope α_n of the differential cross section, and $\rho_n = -0.16 \pm 0.3$ for the ratio of the real to the imaginary part of the forward scattering amplitude. The D-wave function of the deuteron was found to give a non-negligible contribution to the coherent reaction. (auth)

43955 PRODUCTION OF THE $K^-\pi^+\pi^-n$ FINAL STATE IN K^-d INTERACTIONS AT 5.5 GeV/c. Davis, R. (Univ. of Kansas, Lawrence); Ammar, R.; Kropac, W.; (and others). Nucl. Phys.; B44: No. 1, 45-82(1972).

The reaction $K^-d \rightarrow K^-\pi^+\pi^-n\ p_S$ was studied in a bubble chamber experiment. The cross section was measured to be 1.3 ± 0.2 mb. The final state is dominated by $\bar{K}^{*0}(890)$, $\bar{K}^{*0}(1420)$ and $\Delta^-(1236)$ production. Partial cross sections, differential cross sections and decay angular distributions of the $\bar{K}^{*0}(890)$ $\Delta^-(1236)$ final state were found to give good agreement with the predictions of Bialas and Zalewski obtained from the quark model. The final state $K^-\pi^+\Delta^-(1236)$ is analyzed by use of the Van Hove plot. (auth)

43956 MEASUREMENT OF THE $K_L + p \rightarrow K_S + p$ REGENERATION AMPLITUDE AT HIGH ENERGIES. Dubna-Serpukhov-Budapest Collaboration. Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 259-64(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The measurement of the K^0 regeneration amplitude in the energy range 15 to 35 GeV using the Serpukhov proton synchrotron is reported. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 42832.

General

Refer also to abstracts 44129, 44218, and 44335.

43957 REMARKS CONCERNING A PROPOSED TWO-COMPONENT SPIN-½ WAVE EQUATION. Grotch, H.; Kazes, E. (Pennsylvania State Univ., University Park). Phys. Rev., D; 5: No. 12, 3277-9(15 Jun 1972).

Two-component equations of the form proposed by Biedenharn, Han, and van Dam are discussed for the case in which the parity operator is strictly internal. It is shown that these equations lack conventional translation and Lorentz invariance. The connection between these equations and the Dirac equation is discussed and it is shown that the solutions of the Dirac equation may be constructed from the solutions of one of the two-component equations. (auth)

43958 WHERE ARE THE CORRECTIONS TO THE GOLDBERGER–TREIMAN RELATION? Pagels, Heinz; Zepeda, A. (Rockefeller Univ., New York). Phys. Rev., D; 5: No. 12, 3262-8(15 Jun 1972).

On the basis of unsubtracted dispersion relations it is pointed out that theoretical estimates fail to account for the corrections to the Goldberger–Treiman relation $\Delta = 1 - Mg_A/gf_\pi \simeq 0.08 \pm 0.02$ by one to two orders of magnitude. As a new result an exact threshold theorem is proved for the absorptive part of K(t), the pion–nucleon form factor, by doing the full three-body angular integrations and using current-algebra low-energy theorems for the 3π processes. In the chiral-SU(2) ⊗ SU(2)-symmetry world in which the pion mass vanishes the result is $\mathrm{Im}K(t) = [gt^2/3(8\pi)^3f_\pi^4][{}^1\!/_3 g_A^2({}^5\!/_2 - {}^{17}\!/_{35}\,\pi^2) - {}^7\!/_8]$ as $t \rightarrow 0$, the threshold point. This leads to an estimate of Δ which fails by two orders of magnitude. It is also shown that the pion spectral function in the chiral-symmetric world behaves like $\rho_\pi(t) = 8t/3(8\pi)^4f_\pi^4$ as $t \rightarrow 0$. As a way out of this negative result (i) subtractions in the dispersion relation, (ii) new values for g and g_A, and (iii) a heavy pion as possibilities, are considered. (auth)

43959 STATISTICAL VIEW OF EXCLUSIVE AND INCLUSIVE CROSS SECTIONS. Biebl, K.-J.; Wolf, J. Nucl. Phys.; B44: No. 1, 301-20(1972).

The interrelations between exclusive and inclusive cross sections are investigated by means of efficiency matrices. A partition function Z is used as a generating functional for these cross sections which yields similarly also topological and other mixed cross sections. Regarding the partition function itself as a cross section, the general properties of Z and of statistical quantities derived from ln Z are investigated as functions of the chemical potentials. These statistical methods are used to analyze three simple examples of data for multiplicity distributions, in particular for the third distribution from the Echo Lake experiment a behavior of Z is found which has similarities with a phase transition in statistical mechanics. (auth)

43960 GROSS STRUCTURE OF HIGH ENERGY MULTIPLE PRODUCTION. THE t-CUT PHASE VOLUME DISTRIBUTIONS. Namiki, Mikio; Ohba, Ichiro; Yap, Sue-pin (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1247-66(Apr 1972).

The phase volume effects on the gross structure of high energy multiple productions are analyzed by means of analytical and numerical calculations. It is shown that those modified phase volume distributions which are obtained by restricting t-variables within the region $|t_i| \lesssim 1(\mathrm{GeV}/c)^2$ can fairly well reproduce the gross structure of experimental distributions. In particular, the invariant mass distribution of a subgroup of secondary particles, the one-particle energy-momentum distribution, and the energy dependence of the total cross section with a definite multiplicity are analyzed in detail. The fire ball model and the assumption of the scaling law or the limiting fragmentation are briefly discussed on the t-cut phase volume analysis. (auth)

43961 HOW TO CONSTRUCT WAVE EQUATIONS WHEN MASS LEVELS ARE KNOWN. Miyazaki, Tadashi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1385-95(Apr 1972).

A unified treatment is formulated for constructing wave equations when mass spectra are given. (auth)

43962 POSSIBLE RELATIONS BETWEEN CURRENT ALGEBRA AND MESON POLE DOMINANCE. Renner, B. (Univ., Hamburg). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 241-50 (1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The suggestion is made there is an overlap among the information obtained from current algebra and from meson pole dominance principles. In simple models it is shown that current algebra results can be rederived from meson pole dominance principles alone, up to an unknown scale of the weak axial current. A noncompact alternative to the usual $SU_2 \times SU_2$ current algebra is shown to be inconsistent with meson pole dominance. (auth)

43963 CURRENT COMMUTATORS AT SMALL TIME DIFFERENCES. Farkas, I.; Pocsik, G. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 251-8 (1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

Using the equal-time current algebra and the divergence conditions, the current commutators for small time differences are calculated. It is shown that the commutators are explicitly model-dependent and the contributions of the symmetry-breaking terms do not drop out. The physical content of the current commutators of non-equal time is discussed in terms of new sum rules. It is pointed out that the disconnected contributions are necessary for the consistency of the sum rules. The sum rules favor the field algebra. (auth)

Electromagnetic

Refer also to abstracts 43104, 44103, and 44148.

43964 (BNL-tr-480) MAGNETIC BREMSSTRAHLUNG: A NEW TOOL FOR RESEARCH. Kapitsa, S. P. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Priroda; No. 10, 22-7(1971). 19p. Dep. NTIS.

The research applications of magnetic bremsstrahlung and its production mechanism are reviewed. Also a storage ring facility for the production of magnetic bremsstrahlung is described. Synchrotron radiation of 10 to 10,000 eV is discussed. (J.F.P.)

43965 ABSORPTIVE CORRECTIONS IN THE PHOTOPRODUCTION OF CHARGED π-MESONS. Kroll, P. (Freie Univ., Berlin). Z. Phys.; 252: No. 3, 219-36(1972).

A Regge-pole model with π-, ρ-, A_2- and R-meson exchange and absorptive corrections are used to reproduce the $\pi^\pm$ photoproduction data in the large s, small |t| region. The starting point for the calculation of the absorptive corrections is the Regge-pole model for invariant functions. (auth)

43966 SCALING BEHAVIOR IN THE PARTON MODEL. Van Neerven, W. L.; Van Royen, R. P. (Univ. of Nijmegen, Netherlands). Nucl. Phys.; B43: 119-24(15 Jun 1972).

The remarkable scaling properties of the structure functions in the deep-inelastic electron-proton scattering experiments were explained fairly well in the parton model. It is shown that the scaling behavior for the structure function $W_1(\nu,q^2)$ cannot be derived from the usual assumptions of the parton model. (auth)

43967 MULTI-REGGE MODEL APPLIED TO HIGH-ENERGY QUASI-INCLUSIVE PHOTOPRODUCTION. Risk, C. (Univ. of California, Berkeley); Swanson, W. P.; Friedman, J. H. Nucl. Phys.; B43: 178-88(15 Jun 1972).

Inclusive photoproduction data in the energy range $E_\gamma = 9.0$ to 18.0 GeV are compared to the multi-Regge model. The model incorporates vector-dominance coupling of the photon, the Chew–Pignotti algorithm for charge assignment, and correct treatment of n-body phase space. A technique of ordering the particles according to longitudinal momentum is used to enhance features of the data and provide a more sensitive test of the model. The model is compared to mass distributions, separation of particles in rapidity, longitudinal momentum distributions, topological cross-sections and charge orderings of secondaries. A reasonable description of the data is achieved, using parameters derived from pp and K^+p experiments. Within this framework, it is found that the class of diagrams involving γ coupling to the ρ are not adequate to describe all aspects of the data, and that other couplings are present to a significant degree. (auth)

43968 DISPERSION RELATION CALCULATION OF NEUTRAL π MESON ELECTROPRODUCTION IN THE RESONANCE REGION. Devenish, R. C. E. (University Coll., London). Nucl. Phys.; B43: 228-52(15 Jun 1972).

Neutral electropion production $ep \to ep\pi^0$ is calculated using resonance saturated fixed t dispersion relations. In the first resonance region it is found that the addition of higher resonances produces some small changes from the well known M_{1+} dominance solution and that small s-wave unitarity corrections are important in the interference terms. In the second resonance region it is shown that the D_{13} resonance is required to explain the data and that our calculation gives the background contribution correctly. Above the second resonance it is found that the calculation gives the same order of magnitude as the data at backward pion production angles. (auth)

43969 SINGLE-PARTICLE ELECTROPRODUCTION AT HIGH ENERGY. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Nucl. Phys.; B43: 279-88(15 Jun 1972).

Single-particle electroproduction is discussed in the framework of the covariant parton model. It is found that the discussion of the process is model dependent, but that two contributions are likely to occur. One corresponds to a term found by Weis in a different discussion, and the other resembles a parton-model term suggested by Roy. It is possible that both terms have similar phenomenological consequences, with the amplitude falling off in Bjorken limit at a rate equal to the fall-off of form factors at large momentum transfer. The relation of these terms to fixed poles and to light-cone limits is clarified. (auth)

43970 SCALING IN ELECTRON SCATTERING AND COMPOSITENESS. Zachariasen, F. (California Inst. of Tech., Pasadena). Nucl. Phys.; B43: 355-64(15 Jun 1972).

It is argued that scaling of the structure functions in deep inelastic electron scattering follows from the assumption that the nucleon is composite alone, and that no further assumption about what it is composed of is required. In particular, it is not necessary to assume the existence of point-like constituents ("partons") in the nucleon. (auth)

43971 ANALYSIS OF FORWARD COMPTON SCATTERING. Tait, N. R. S.; White, J. N. J. (Daresbury Nuclear Physics Lab., Warrington, Eng.). Nucl. Phys.; B43: 27-35(15 Jun 1972).

Data from a recent Daresbury experiment on the total photoabsorption cross section on protons are combined with existing data from similar (direct hadron detection) experiments in a standard sum rule analysis. The magnitude of the conjectured J = 0 singularity (possible fixed pole) in the spin-averaged forward amplitude is shown to depend in a definite way on the Regge fit to the data. (auth)

43972 MODEL FOR DEEP INELASTIC STRUCTURE FUNCTIONS. Kleinert, H. (Freie Univ., Berlin). Nucl. Phys.; B43: 301-30(15 Jun 1972).

The electromagnetic structure functions are calculated from an infinite component wave equation which is a relativistic generalization of the Schrödinger equation of the H atom. The elastic form factor has a dipole structure leading to the threshold behavior of $F_2(\xi) \alpha (1-\xi)^3$ at $\xi = 1$. Apart from that, $F_2(\xi)$ differs from the structure function of the proton by being larger and by having a zero at $\xi = 0$. While the amplitude appears at first sight to be typical resonance model for the structure functions, all properties of the result allow for a direct interpretation in terms of the parton picture. A specific choice of the mass parameters reduces the model to that of the H atom. In this limiting case it is shown that the result is almost identical to what one would obtain from the parton approximation. (auth)

43973 BOUNDS ON DEEP INELASTIC STRUCTURE FUNCTIONS. Pallua, S.; Renner, B. (Univ., Hamburg). Nucl. Phys.; B43: 331-44(15 Jun 1972).

Bounds on deep-inelastic structure functions for virtual photon and neutrino reactions are given, making two assumptions: (i) in the t-channel only non-exotic exchanges are admitted, and (ii) exotic contributions in the s-channel are due only to an SU(3) singlet in the t-channel, such as the pomeron. Consequences of assuming (i) alone and of assuming (i) and (ii) together are listed separately, they include: (a) a bound on the ratio of neutron and proton structure functions $|F_{\gamma N}(\omega)/F_{\gamma p}(\omega)| \geq 1/4$, following from assumption (i) alone, and (b) bounds on the nucleon weak structure functions in terms of supposedly known nucleon electromagnetic structure functions. These bounds are strictly valid only for the weak vector contributions, and they can be used for the axial contributions if these two are asymptotically equal. (auth)

43974 ANOMALOUS BEHAVIOR OF A MASSIVE SPIN TWO CHARGED PARTICLE IN AN EXTERNAL ELECTROMAGNETIC FIELD. Velo, G. (CERN, Geneva. Univ., Bologna). Nucl. Phys.; B43: 389-401(15 Jun 1972).

A critical study of the behavior of a massive spin two charged particle in an external electromagnetic field is made. There is a unique Lagrangian which does not increase the number of degrees of freedom required for the description of a spin two particle. However, other unsatisfactory features are hidden in the Lagrangian equations. They possess solutions which either fail to propagate or propagate at a speed greater than the speed of light. (auth)

43975 NONFORWARD FIXED MASS SUM RULES. de Alwis, S. P. (Cambridge Univ., Eng.). Nucl. Phys.; B43: 579-90(15 Jun 1972).

The derivation of nonforward ($t < 0$) fixed mass sum rules for electro (or neutrino) production structure functions from light cone methods is investigated. These sum rules enable one to define a regularization of those sum rules which are formally divergent at $t = 0$. The $J = 0$ fixed mass sum rule for electroproduction is treated as an explicit example. (auth)

43976 COHERENT PRODUCTION IN THE NUCLEAR COULOMB FIELD. Faeldt, Goeran (Univ. of Lund, Sweden). Nucl. Phys.; B43: 591-604(15 Jun 1972).

Formulas are derived for hadronic production in the Coulomb field of a nucleus. They are valid for realistic charge and matter distributions and account for absorption and elastic Coulomb scattering. Formulas of this kind have not been given before. The corresponding strong production process is discussed where results differing from previous findings are obtained. (auth)

43977 EXACT PLANE-WAVE SOLUTION OF BORN–INFELD ELECTRODYNAMICS. Boillat, G. (Univ., Clermont-Ferrand, France). Lett. Nuovo Cim.; 4: No. 7, 274-6(17 Jun 1972).

A new exact plane-wave solution of the Born–Infeld equations for nonlinear electrodynamics is derived. (L.B.S.)

43978 SOLUTION OF DYSON EQUATIONS FOR ELECTRON AND PHOTON GREEN'S FUNCTIONS IN THE $\alpha(\alpha L)^n$ APPROXIMATION. Truten, V. I.; Fomin, P. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 12, 2017-28(Dec 1971). (In Russian).

The renormalized Dyson equations for photon Green's function D and the electron one G are solved in the so-called $\alpha(\alpha L)^n$-approximation in which all the terms of the type $\alpha(\alpha L)^n$ are summarized, where α is a renormalized coupling constant and L is a general symbol for large logarithmic parameters of the type $\ln k^2/m^2$, $\ln p^2/m^2$. (auth)

43979 GLAUBER MODEL AND PHOTOPRODUCTION OF VECTOR NEUTRAL MESONS ON NUCLEONS. Gershun, V. D.; Kolodyazhnyi, B. G. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 12, 2029-35(Dec 1971). (In Russian).

Double-scattering contributions to the amplitude of photoproduction of the vector neutral mesons on nucleons are considered with regard for the difference of (p′,p′)- and (n′p′)-elastic scattering quark amplitudes in the terms of a quark model. The relations between imaginary parts of the forward photoproduction amplitudes and total cross sections of elastic scattering processes are obtained. The numerical estimation of these relations shows that total double-scattering contributions to the given model are negligibly small as compared to single-scattering contributions. (auth)

43980 EFFECT OF F_π AND G_{EN} FORM FACTORS IN THE REACTION $ep \rightarrow en\pi^+$ WITH POLARIZED ELECTRONS. Omelaenko, A. S. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 12, 2065-6(Dec 1971). (In Russian).

The dependence of the secondary component arising from the cross section of the reaction $ep \rightarrow ep\pi^+$ of a polarized initial electron on the form factors F_π and G_{EN} was investigated. This investigation was conducted for the region of the first $N\pi$-resonance and within the framework of an isobaric model. (tr-auth)

43981 $\omega-\rho$ ELECTROMAGNETIC MIXING. Gourdin, M. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). pp. 439-52 of Atti del Convegno Mendeleeviano. Verde, M. (ed). Turin; Vincenzo Bono (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The $\omega-\rho$ electromagnetic mixing in $e^+ + e^- \rightarrow \pi^+ + \pi^-$ interactions is treated. Experimental evidence, the mixing formalism, general features of $\omega-\rho$ mixing, the $\omega \rightarrow 2\pi$ decay, and the $\rho \rightarrow 3\pi$ decay are covered. (J.F.P.)

43982 VANISHING LONGITUDINAL CROSS SECTIONS AND OPERATOR SCHWINGER TERMS. Creutz, Michael (Univ. of Maryland, College Park). Phys. Rev., D; 5: No. 12, 3269-72(15 Jun 1972).

It is shown that a vanishing total cross section for virtual longitudinal photons on a hadronic target is compatible with the presence of nontrivial operator-valued Schwinger terms appearing in the one-particle matrix element of the commutator of two electromagnetic currents. However, this requires a violation of either Bjorken scaling or the usual subtraction assumptions on virtual Compton amplitudes. (auth)

43983 FIXED POLES IN COMPTON SCATTERING: LIGHT-CONE APPROACH. Bander, Myron (Univ. of California, Irvine). Phys. Rev., D; 5: No. 12, 3274-6(15 Jun 1972).

The algebra of currents on the light cone is extended to the covariant retarded product of these currents. This extension is applied to the study of fixed poles in elastic Compton scattering and in inelastic Compton scattering. (auth)

43984 CLASSICAL ELECTRODYNAMICS OF POINT PARTICLES. Itzykson, C.; Voros, A. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev., D; 5: No. 12, 2939-41(15 Jun 1972).

Equations of motion are derived for a pointlike relativistic spinning particle in an external electromagnetic field, neglecting radiative and quantum corrections. The equations are nonlinear with singular points appearing when the field is higher than a critical value. An analogy is suggested between this and the noncausal propagation of solutions of quantum equations for high spins in external fields. (auth)

43985 CLUSTER EXPANSION IN A RENORMALIZABLE THEORY: THE ELASTIC FORM FACTOR. Cahalan, Robert F. (Univ. of Illinois, Urbana). Phys. Rev., D; 5: No. 12, 2999-3021(15 Jun 1972).

The method of cluster decomposition, well known in statistical mechanics and recently applied to φ^3 field theory by Chang, Yan, and Yao and by Campbell and Chang, is here extended to the calculation of the electromagnetic form factor in a renormalizable neutral pseudoscalar theory. In particular the set of so-called uncrossed "rainbow" diagrams are analyzed in the limit of spacelike momentum transfer squared, q^2, much larger than the pion or proton mass squared, μ^2 or M^2. In this limit the Dirac form factor behaves as $F_1(q^2) = B(g^2, \mu^2/m^2, M^2/m^2)(-q^2/m^2)^{-A(g^2)}$ where g is the $\pi^0 p$ coupling and m is an arbitrary scale factor. The functions A and B are shown to arise in momentum space from "volume" and "surface" effects, respectively. They are given as a power series in g^2. The first two terms in A are calculated explicitly, giving $A = (g^2/32\pi^2) + 5/2 (g^2/32\pi^2)^2 + \cdots$. (auth)

43986 HIGH-ENERGY DELBRUECK SCATTERING FROM NUCLEI. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Phys. Rev., D; 5: No. 12, 3077-87(15 Jun 1972).

The elastic scattering of a high-energy photon from a heavy nucleus, considered to be a static Coulomb field due to the charge Ze, is studied. Exchange of an arbitrarily large number of photons with the nucleus is taken into account, and the effect of this multiphoton exchange is found to be very large, particularly for momentum transfers which are large compared with the rest mass of the electron. In addition, an interesting theoretical problem in this connection is formulated but unfortunately not solved. (auth)

43987 COULOMB SCATTERING OF A CHARGED VECTOR MESON WITH AN ELECTRIC DIPOLE MOMENT. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Phys. Rev., D; 5: No. 12, 3247-52(15 Jun 1972).

By including an electric dipole moment that leads to parity nonconservation, a previous investigation of the scattering of a charged vector meson by a static Yukawa potential, or, in particular, a static Coulomb field is extended. The existence of a solution that satisfies Meixner's corner condition requires the following inequality between the anomalous magnetic moment κ and the electric dipole moment w: $\kappa > 1 + w^2$. In the special case where the electric dipole moment is absent, this condition reduces to the one obtained previously. (auth)

43988 INTERACTION OF A CIRCULARLY POLARIZED LASER PULSE WITH FREE ELECTRONS. Steiger, A. D.; Woods, C. H. (Univ. of California, Livermore). Phys. Rev., D; 5: No. 12, 2912-14(15 Jun 1972).

The interaction of an intense, circularly polarized, electromagnetic wave of finite duration with a free electron is analyzed classically. The effects of radiative reaction and intensity gradients in smoothly varying pulses are treated relativistically. It is shown that the effect of radiative reaction is to impart to the electron a final energy which depends only on the energy per unit area carried by the wave. (auth)

43989 CALCULATION OF FORWARD PROTON–PROTON BREMSSTRAHLUNG AT 51.8 MeV. McGuire, J. H. (Texas A and M Univ., College Station). Phys. Lett.; 40B: No. 1, 41-2(12 Jun 1972).

The double differential proton–proton bremsstrahlung cross section near $10^0 - 10^0$ is computed in the coplanar geometry by using a simple one-pion-exchange off-shell extrapolation of the elastic phase shifts. This relatively simple calculation, which has given excellent agreement with experiments at θ_1, $\theta_2 > 25^0$, does not agree with recent Japanese $8.5^0 - 8.5^0$ data at 51.8 MeV. (auth)

43990 NEW GORDON DECOMPOSITION METHOD FOR THE DIRAC CURRENT. Phan-Van-Loc; Boisseau, Bruno (Univ., Tours, France). Compt. Rend., Ser. B; 274: No. 8, 513-15(21 Feb 1972). (In French).

A Lagrangian containing a term representing the interaction between a Dirac electron and the electromagnetic field is sought. Applying the Lagrange equations to the Dirac current, J_μ, results in an automatic decomposition into the Gordon form. (France)

43991 VIRTUAL $\gamma\gamma$ SCATTERING AND NEW TYPE OF SCALING. Chernyak, V. L. (Novosibirsk State Univ., USSR). JETP Lett. (USSR) (Engl. Transl.); 15: No. 8, 348-51(20 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 8, 491-5(20 Apr 1972).

Quantitative predictions for asymptotic form of the amplitude of virtual forward $\gamma + \gamma$ scattering in the region of large photon masses are presented. Scalar photons are considered. (J.F.P.)

43992 CHERENKOV EFFECT AND ABSORPTION-EMISSION OF ENERGY-MOMENTUM QUANTA OF THE FRESNEL VANISHING WAVE. Vigoureux, J. M. (Univ., Reims). Compt. Rend., Ser. B; 274: No. 11, 725-8(13 Mar 1972). (In French).

Though vanishing waves are normally associated with physical sources or scattering centers, it has been demonstrated by Carniglia and Mandel that the electromagnetic field can be studied as a free field, if a passive homogeneous medium of index n in a half sphere is considered. The results obtained are generalized in the case of two half-spaces with nonunit indices in view of studying the interaction between an electromagnetic field and a free electron. (France)

43993 ELECTRON SELF-ENERGY IN A MAGNETIC FIELD. Constantinescu, D. H. (Scuola Normale Superiore, Pisa, Italy). Nucl. Phys.; B44: No. 1, 288-300(1972).

In the lowest order in the fine-structure constant, the electron self-energy in an external magnetic field can be written in the form of a double integral representation containing the exact information about the radiative shift and width of the energy levels, without approximation in the field strength. In the low-field expansion of the radiative shift, the leading term is conveniently interpreted in terms of the electron's anomalous magnetic moment, while in very strong fields the enhancement of the cyclotron motion makes the shift a positive, slowly increasing function of the field intensity. It follows that, even in superstrong magnetic fields, the electromagnetic interaction cannot give rise to an instability of the electron–positron vacuum. (auth)

43994 VACUUM POLARIZATION CORRECTION TO ELASTIC ELECTRON AND MUON SCATTERING IN AN INTENSE FIELD AND PAIR ELECTRO- AND MUOPRODUCTION. Ritus, V. I. (Lebedev Inst. of Physics, Moscow). Nucl. Phys.; B44: No. 1, 236-52(1972).

For electrons and muons interacting with an intense electromagnetic field the elastic scattering amplitudes taking into account vacuum polarization, the probabilities of pair production, and the polarization corrections to probabilities of radiation are found. The limiting cases of weak and strong fields and of a infinitely massive particle, the elastic scattering amplitude of which coincides with the amplitude of a vacuum–vacuum transition in a pair creating superposition of a Coulomb and a crossed field, are considered in detail. (auth)

43995 REGGE-POLE MODEL FOR INELASTIC e–P SCATTERING. Sakuraoka, Mitsuru; Kasahara, Tyuyo; Akiba, Tomoya; Ebata, Takeshi (Tohoku Univ, Sendai). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1267-75(Apr 1972).

A phenomenological description of inelastic e-p scattering is presented based on a Regge-pole model, which gives approximate fits to the structure functions for varying squared photon mass q^2 and an insight into a simple connection between the real and virtual photoabsorptions. An essential point is to assume that the Pomeron and the ordinary Regge poles f^0, A_2^0 are expressed by scaling functions irrespective of q^2 except for a region near the absorption threshold. The model apparently requires a "fixed pole" at $J = 0$ whose residue has non-polynomial dependence on q^2. An argument is presented which makes it preferable to interpret the "fixed pole" as a Regge cut having the branch point negative and small at $t = 0$. (auth)

43996 SCALING BEHAVIOR OF ELECTROMAGNETIC STRUCTURE FUNCTIONS OF DEEP INELASTIC e–p SCATTERING IN CHIRAL DYNAMICS. Chikashige, Yuichi; Hosoda, Masataka; Shimbo, Takashi (Tokyo Metropolitan Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1276-88(Apr 1972).

Bjorken's scaling property of inelastic electron scattering is analyzed and explicit calculations of the structure functions are made for all two-body final channels, such as $n\rho^+$, nA_1^+, $n\pi^+$ etc., by using SU(2) × SU(2) phenomenological Lagrangian. The result is compared with the experimentally available data for $e + p \rightarrow e + \text{anything}$. Finally, the results of Callan and Gross, Bloom and Gilman are discussed. (auth)

43997 PARASTATISTICS, LEPTONS, AND THE NEUTRINO THEORY OF LIGHT. Green, H. S. (Univ. of Adelaide). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1400-7(Apr 1972).

The generalization of Fermi statistics of order 2 is applied to the leptons. The theory can account for the existence of two neutrinos, associated with the electron and the muon respectively, and can be extended to account for the existence of the muon. It is shown how the neutrino theory of light can be reformulated, without violating rotational invariance, provided the neutrinos satisfy parastatistics of order 2. (auth)

43998 ANALOGY BETWEEN HADRON AND VIRTUAL PHOTON REACTIONS. Hayashi, Koichi (Kinki Univ., Osaka). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1420-22(Apr 1972).

The vector dominance model is used to investigate the analogy between hadron reactions and processes initiated by a virtual (space-like) photon. The result is applied to inclusive reactions which are some special final-state channels of deep inelastic electron scattering. (L.B.S.)

43999 SINGLE PARTICLE DISTRIBUTION BY VIRTUAL PHOTON. Biyajima, Minoru (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1424-5(Apr 1972).

The single particle distribution by the virtual scalar photon process, $\gamma(A) + B \rightarrow X(c) + \text{anything}$, is considered in the dual resonance model. The scaling law is obtained in the fragmentation region, and the momentum cutoff factor is obtained in the central region. (L.B.S.)

44000 PION FORM FACTOR FROM PION ELECTROPRODUCTION EXPERIMENTS. Hayashi, Koichi (Kinki Univ., Osaka). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1435-8(Apr 1972).

A Regge formalism previously given for electroproduction of a single π^+ meson in the high-energy region is used along with data from a recent DESY experiment to obtain the π form factor. A comparison with results from the vector dominance model and from the electric Born model shows disagreement; possible origins of the discrepancy are discussed. (L.B.S.)

44001 AXIAL-VECTOR (MASSIVE) PHOTON AND p–n MASS DIFFERENCE. Miura, Kimio (Nihon Medical Coll., Kawasaki, Japan); Miyamoto, Yoneji. Progr. Theor. Phys. (Kyoto); 47: No. 4, 1450-1(Apr 1972).

The existence of axial-vector (massive) photon is hypothesized and its contribution to the p−n mass difference is estimated. (L.B.S.)

44002 INTERACTION OF RELATIVISTIC PARTICLES AND FREE ELECTROMAGNETIC WAVES IN THE PRESENCE OF A STATIC HELICAL MAGNET. Palmer, Robert B. (Brookhaven National Lab., Upton, N. Y.). J. Appl. Phys.; 43: No. 7, 3014-23 (Jul 1972).

It is shown that a particle passing along the axis of a helical magnet (in which the field is perpendicular to the axis and rotating as a function of position along the magnet) can be continuously accelerated by its interaction with circularly polarized radiation passing in the same direction. An example is given in which an electron is accelerated to 10 GeV, using a laser of 10^{14} W. A second example shows how pions and kaons might be separated at momenta over 1000 GeV. It is further shown that bunched charged particles passing down the helical magnet will radiate coherent circularly polarized electromagnetic waves, and it is speculated that the required bunching may under some circumstances be self-generating. An example is shown in which a 10-A current of 15-MeV electrons is used to generate a 75-MW beam of 10-μ radiation. (auth)

44003 THEORETICAL IMPLICATIONS OF RECENT ELECTRON–POSITRON COLLIDING BEAM EXPERIMENTS. Sakurai, J. J. (Univ. of California, Los Angeles). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 5-19(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The theoretical consequences of recent electron−positron colliding beam experiments are summarized from the point of view of tests of pure quantum electrodynamics, the study of the vector mesons ρ, ω, φ and the frontier region beyond the ρ, ω and φ. (auth)

44004 LIGHT CONE EXPANSIONS AND APPLICATIONS. Brandt, R. A. (New York Univ., N. Y.). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 21-31(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

Different implications of general light cone expansions of the current products are reviewed. (auth)

44005 RECENT DEVELOPMENTS IN INELASTIC ELECTRON–NUCLEON SCATTERING. Gilman, F. J. (Stanford Univ., Calif.). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 33-49(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

Inelastic electron−nucleon scattering is discussed. The theoretical ideas are compared with recent experimental data on proton and deuteron target. Particular attention is payed to the duality aspect of the data. (auth)

44006 FINITE ENERGY SUM RULES AND SCALING. Nauenberg, M. (Univ. of California, Santa Cruz). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 51-4(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

A conjectured finite-energy sum rule is evaluated for deep-inelastic electron−proton scattering. The possibility that the sum rule is satisfied locally is also examined. (auth)

44007 DEEP-INELASTIC SCATTERING OF POLARIZED ELECTRON BEAM FROM POLARIZED NUCLEON TARGET. Galfi, L.; Gnaedig, P.; Kuti, J.; Niedermayer, F.; Patkos, A. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 85-98(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

Spin-dependent effects in deep-inelastic electron−proton scattering are discussed. (auth)

44008 SCATTERING OF LIGHT BY LIGHT USING ELECTRON–POSITRON COLLIDING BEAMS. Kunszt, Z.; Muradyan, R. M.; Ter Antonyan, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 99-108(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The process $e^- + e^+ \rightarrow \gamma$ + hadrons is discussed. Using automodelity, vector meson dominance and the parton model, an estimate of the deep-inelastic cross section is given, showing that it might be comparable to the cross section of the deep-inelastic reaction $e^- + e^+ \rightarrow H$ + anything H being a singled-out hadron. Some of the one-meson contributions are calculated in the quark model. (auth)

Weak

44009 NEUTRINO REACTIONS ON NUCLEAR TARGET. Smith, R. A.; Moniz, E. J. (Stanford Univ., Calif.). Nucl. Phys.; B43: 605-22(15 Jun 1972).

The systematics of deep inelastic neutrino scattering from complex nuclei is examined by computing the cross section for quasi-elastic scattering and for quasi-free resonance production. Relativistic kinematics is retained for the recoiling particle and the full relativistic hadronic weak vertex. The isobar cross section is expressed in terms of helicity amplitudes of the weak current, defined through an application of the Jacob−Wick formalism to the general isobar-nucleon weak vertex. The cross section is computed analytically for the nuclear Fermi gas model. It is stressed that exactly the same model has already been very successfully applied to inelastic electron scattering from complex nuclei. (auth)

44010 MODEL OF WEAK INTERACTIONS WITH A HEAVY LEPTON. Vancura, A. (Univ. of Trier, Kaiserlautern, Ger.). Nucl. Phys.; B43: 36-44(15 Jun 1972).

A phenomenological model of weak interactions, including a heavy lepton is presented. The discrepancies of the theoretical prediction and experimental results of Ramm are discussed. (auth)

44011 BOUNDS ON THE FORM FACTOR OF K_{13} DECAY. Bourrely, C. (CERN, Geneva. CNRS, Marseille). Nucl. Phys.; B43: 434-44(15 Jun 1972).

Bounds are derived on the form factor f(t) of K_{13} decay valid from the origin to the threshold $(m_\pi + m_K)^2$. If the soft-pion theorem on $f_\pm(t)$ and a bound on the propagator $\Delta(0)$ of the divergence of the strangeness changing current at zero momentum are used as input, upper and lower bounds are obtained, which are close together but which do not fit with experiment; by allowing $\Delta(0)$ to vary as a parameter, there is then better agreement. Some bounds for the decay parameters are also discussed. (auth)

44012 DECAY $\mu \rightarrow e + \nu + \bar{\nu}$ AND RESTRICTIONS FOR THE MASSES OF NEUTRINO AND W BOSON AND VARIANTS OF WEAK INTERACTION. I. PARAMETERS $\rho(\eta \equiv 0)$ AND $\eta(\rho \equiv 3/4)$. Rekalo, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 12, 1937-46(Dec 1971). (In Russian).

The decay $\mu \rightarrow e + \nu + \bar{\nu}$ is considered in the framework of the weak interaction mediated by a charged vector boson on the condition of nonzero mass of the muon neutrino. The possibility of deviation of the muon decay interaction from the standard V−A interaction is taken into account. A general expression for the spectrum of the electrons emitted in the polarized muon decay is obtained, and the experimental values of the isotropic spectrum parameters $\rho(\eta \equiv 0)$ and $\eta(\rho \equiv 3/4)$ are analyzed. As a result, the essential restrictions for the masses of the neutrino and W-boson and variants of weak interaction are obtained. (auth)

44013 SYMMETRY RELATIONS FOR ELASTIC NEUTRINO REACTIONS. Wolfenstein, L. (Carnegie-Mellon Univ., Pittsburgh). Ann. Phys. (N. Y.); 71: No. 2, 569-76(Jun 1972).

General theorems are given relating the reactions $\nu + n \rightarrow \mu^- + p$ and $\bar{\nu} + p \rightarrow \mu^+ + n$ based on CPT invariance, hermiticity, lepton locality, and the G transformation properties of the hadronic current. (auth)

44014 SECOND-CLASS CURRENTS AND RADIATIVE HYPERON DECAYS. Greenberg, D. F. Lett. Nuovo Cim.; 4: No. 7, 277-80(17 Jun 1972).

The contribution of second-class currents to radiative hyperon decays is examined in a model where the process is dominated by a strange axial vector meson in the Q region. Suggestions are made concerning experimental tests of the model. (L.B.S.)

44015 HIGH-ENERGY BEHAVIOR OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Gatto, R. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua). pp 403-37 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

A lecture is given on the summarization of some recent work on the behavior at high momenta of weak and electromagnetic interactions. The most divergent terms which arise from virtual emission and absorption of W bosons are discussed using a naive quark model and current algebra. Second semiweak order, all orders in a free quark model, current algebra calculation at fourth order, extended field algebra, compound field algebra, compound field algebra for leading weak divergences and electron−positron annihilation into hadrons, an alternative approach, and generalized compound field algebra are treated. (J.F.P.)

44016 ANOMALOUS MAGNETIC MOMENT OF THE CHARGED INTERMEDIATE VECTOR BOSON. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Phys. Rev., D; 5: No. 12, 2978-98(15 Jun 1972).

Assuming that the intermediate vector boson for weak interactions has no strong interactions, the Corben—Schwinger problem of the scattering of a charged vector meson with anomalous magnetic moment by an external static Yukawa potential, or in particular a static Coulomb field is reinvestigated. Meixner's corner condition of finite integrated energy in every bounded region is applied in the neighborhood of the singularity of the Yukawa potential, and it is found that the Corben—Schwinger problem, although nonrenormalizable, possesses a finite, unique solution if and only if the anomalous magnetic moment is larger than unity. It is therefore a characteristic of nonrenormalizable theories that there may be lower bounds to coupling constants. Experimental determination of the anomalous magnetic moment of the intermediate vector boson is thus of great importance. Furthermore, because certain differential equations happen to be solvable in terms of Bessel functions, an explicit perturbation expansion for weak coupling can be given for this scattering process. (auth)

44017 LIGHT-CONE STRUCTURES AND SUM RULES AS SEEN IN THE PARTON DUAL-RESONANCE MODEL. Lee, S. Y.; Yang, T. C.; Yu, L. P. (Univ. of California, San Diego, La Jolla). Phys. Rev., D; 5: No. 12, 3210-25(15 Jun 1972).

A simple and unique asymptotic symmetry scheme is proposed to incorporate spins, SU(3), CPT invariance, and the generalized Bose statistics into the parton dual-resonance model for deep-inelastic lepton-hadron reactions. The scheme embodies Harari—Rosner quark duality diagrams, adopts Chan—Paton SU(3)-symmetry factors, identifies Mandelstam, Bardakei, and Halpern's multiplicative quark model in the Bjorken limit, and generates Fritzsch and Gell-Mann's light-cone structures identically. The dynamical (parton-dual-resonance-model) approach is therefore unified with the symmetry (light-cone) approach, and the complementarity between these two is established. Light-cone sum rules are derived, and a new sum rule is suggested. As a further application of this scheme, the complete sets of bilocal light-cone structures occurring in the two-heavy-boson processes are calculated. (auth)

44018 NONLEPTONIC WEAK DECAYS OF HYPERONS AND THE ALGEBRA OF CURRENTS. Yakimiw, E. (Faculte des Sciences, Orsay, France). Can. J. Phys.; 50: No. 9, 873-8 (1 May 1972).

A large parity-violating spurion contribution in the Kumar—Pati theory on nonleptonic weak hyperon decays is not consistent with the theory. The case wherein the spin-$^3/_2{}^+$ decuplet and the Y_0^*(1405 MeV) singlet contributions are taken into account was re-examined. The best χ^2 fit in this model leads to an uncomfortably large contribution of the Y_0^* to the parity-conserving $\Sigma_{\pm}^{\pm}$ amplitudes, which cannot be lowered by introducing a {27}-plet weak spurion effect. Two alternative theories are presented: either the SU(3)-symmetry breaking is negligibly small ($f_k m_k \simeq 0$), the μ/λ octet weak spurion ratio is low ($\mu/\lambda \simeq -0.5$), and the parity-conserving Y_0^* contribution is high (more than 90% of the $B(\Sigma_+^+)$ amplitude), or the SU(3)-symmetry breaking is important ($f_k m_k \simeq 6 \times 10^{-6}$ MeV), the μ/λ ratio is high ($\mu/\lambda \simeq -0.75$), and the parity-conserving Y_0^* contribution is small (less than 30% of the $B(\Sigma_+^+)$ amplitude). (auth) (Canada)

44019 GENERALIZED SIMILARITY RELATION. Katuya, Mituaki (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1430-2(Apr 1972).

A generalization of the similarity relation is proposed, which is as follows: The matrix elements for SU(3) octet currents have the same SU(3) structures for the series $J^P = 0^-, 1^+, 2^-, \ldots$ and $0^+, 1^-, 2^+ \ldots$, irrespective of interactions. From this hypothesis, the matrix elements for hadronic 1^- and 1^+ trilinear octet currents are constructed, which can be compared with experiment on pseudoscalar meson production in neutrino—nucleon collisions. The main results are shown for allowed and forbidden transitions through both vector and axial-vector currents. (L.B.S.)

44020 BROKEN SCALE INVARIANCE IN INELASTIC LEPTON—NUCLEON SCATTERING. Sartori, G. (Univ., Padua). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 55-73(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

Broken scale invariance in inelastic lepton—nucleon scattering is discussed studying current commutators near to light-cone and their equal time limits. Models, based on Wilson's ideas, are proposed to provide a more general frame than canonical models. (auth)

44021 LEPTONIC AND SEMI-LEPTONIC WEAK INTERACTIONS. Pietschmann, H. (Univ., Vienna). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 153-63(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

New results on leptonic and semi-leptonic weak processes are reviewed. Recent references on this subject are accumulated. (auth)

44022 REMARKS ON A NEW FIT OF THE PARAMETERS FOR CABIBBO'S THEORY. Frenkel, A.; Hasenfratz, P. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 165-71(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

Some of the theoretical uncertainties inherent in the theory of weak interactions and their possible influence on the fitted value of the Cabibbo angle are discussed. Special attention is given to the problem of the q^2-dependence of the form factors. (auth)

Strong (General)

Refer also to abstracts 43831 and 44351.

44023 GENERATING FUNCTIONALS FOR MULTIPLE PARTICLE PRODUCTION: SEMI-INCLUSIVE CROSS SECTIONS, MOMENTUM DISTRIBUTIONS, AND CORRELATIONS. Koba, Z.; Nielsen, H. B.; Olesen, P. (Univ. of Copenhagen). Nucl. Phys.; B43: 125-46(15 Jun 1972).

A generating functional formalism for multiple production in high-energy hadron collisions is developed. It includes, as two special cases, Predazzi—Veneziano's formula and Mueller's generating function. It summarizes in a concise way the kinematical relations among exclusive, semi-inclusive, and inclusive cross sections, single- and multiple-particle momentum distribution and correlation functions, their partial and total integrals, as well as the energy-momentum sum rules. A few simple cases and the asymptotic limit, which reveals the scaling behavior, are treated in this framework. The following important equivalence theorem is shown: the information contained in the set of all inclusive many-particle cross sections is equivalent to the information contained in the set of all exclusive many-body cross sections. (auth)

44024 MULTIPLICITIES AND CORRELATIONS IN HADRON PRODUCTION PROCESSES. Webber, B. R. (Cambridge Univ., Eng.). Nucl. Phys.; B43: 541-68(15 Jun 1972).

The class of hadron scattering experiments is discussed in which one measures the numbers of particles of various types that are produced, but not their momenta. The generating function technique of Mueller is used to relate the quantities that may be measured in these experiments to multiparticle correlations. The effects of correlations due to resonance production and conservation constraints are examined. Conservation sum rules for correlations are derived from the connection between correlations and inclusive cross sections. The momentum sum rule is used to incorporate momentum conservation into the uncorrelated jet model. It is argued that charge conservation is the most important constraint at very high energies, and the most general charge-conserving generating function is derived from the corresponding sum rule. Ways of measuring the parameters of this generating function are discussed. The simplest charge-conserving models are examined, and many predictions of high-energy results are made on the basis of these models. (auth)

44025 SELECTION RULE FOR HADRON SCATTERINGS. Lo, S. Y. (Univ. of Glasgow). Lett. Nuovo Cim.; 4: No. 7, 262-6(17 Jun 1972).

The known two-body scattering processes are divided into six classes according to the number of nonstraight lines in quark diagrams. Processes with exactly similar quark diagrams are selected; it is observed that the difference among processes in the same subclass is approximately in multiples of half integers. (L.B.S.)

44026 GEOMETRICAL PROPERTIES OF THE FUNDAMENTAL INTERACTIONS. Michel, L.; Radicati, L. A. (Institut des Hautes Etudes Scientifiques, Bures-Sur-Yvette, France). pp 377-89 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

A lecture is given on the striking similarity in the way the strong, electromagnetic and weak interactions break the underlying symmetry. It is shown that the directions defined in the internal symmetry space by both the electromagnetic and the lepton fields have simple and unique geometrical properties.

Several approximations exist for the strong interaction symmetry property; some of them have the same type of characteristic geometrical behavior as the electromagnetic and weak interactions. (J.F.P.)

44027 DYNAMICS OF STRONG INTERACTION. Fubini, S. (Univ., Turin). pp 391-4 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969)..

A brief summary is given of strong interaction theory. It is pointed out that there is not yet a fundamental understanding of the theory, but that there are now ideas which will lead to a satisfactory understanding of this interaction. (J.F.P.)

44028 RELATIONSHIP BETWEEN REGGE SLOPES AND LORENTZ POLES IN THE AMATI–BERTOCCHI–FUBINI–STANGHELLINI–TONIN MODEL. Misheloff, Michael N. (Princeton Univ., N. J.). Phys. Rev., D; 5: No. 12, 3225-30(15 Jun 1972).

The behavior near t = 0 of the factorized residue functions at the Regge poles in the Amati–Bertocchi–Fubini–Stanghellini–Tonin ladder model is derived. This behavior is used in a stationary principle to deduce an exact expression for the slopes of Regge trajectories at t = 0 in terms of Lorentz-pole positions and residues. Generalizations to arbitrary multiperipheral models are discussed. (auth)

44029 HADRONIC MATTER AT HIGH DENSITY. Carlitz, Robert D. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., D; 5: No. 12, 3231-42(15 Jun 1972).

The density of hadron levels $\rho(m)$ was derived from the statistical bootstrap model to have the asymptotic form $\rho(m) \sim cm^a e^{bm}$ with $a \leq -5/2$. The properties of ultradense hadronic matter characterized by level densities of this type are studied. If $a < -5/2$ (as is preferred by the bootstrap model), it is shown that hadronic matter may be thermodynamically unstable at high densities. This instability is characterized by macroscopic fluctuations of the energy density and the existence of a negative specific heat. Implications of the instability are discussed with reference to high-energy collisions and astrophysics. (auth)

44030 FIRST AND SECOND FACTORIZATION IN A DUAL MULTIPARTICLE THEORY WITH NONLINEAR TRAJECTORIES. Yu, S. (Univ. of Washington, Seattle); Baker, M.; Coon, D. D. Phys. Rev., D; 5: No. 12, 3108-21(15 Jun 1972).

The N-point tree graphs of a dual-resonance theory with nonlinear trajectories are factorized. The factorization procedure applies equally well with the external lines on or off the mass shell. The particle spectrum of the theory is found to have a degeneracy of approximately 6^l for the lth level. Since the trajectory is logarithmic, the asymptotic density of levels grows only as some power of the mass. The techniques used in first factorization are applied to second factorization to arrive at an amplitude for processes involving two external particles with nonzero spins. Two sets of linear-dependence relations among the amplitudes obtained by factorization are proven. (auth)

44031 NATURE OF THE ρ REGGE EXCHANGE AMPLITUDE. Snider, Dale R. (Univ. of Wisconsin, Milwaukee). Phys. Rev., D; 5: No. 12, 3161-9(15 Jun 1972).

Using the multiperipheral model, and including the effects of the ρ-P Regge cut, a partial bootstrap is obtained for the ρ Regge exchange amplitude. The singularity is not a pole, but rather a cut with a somewhat localized discontinuity. However, it can be approximated by a phenomenological pole. (auth)

44032 RELATIVISTIC QUARK MODELS BASED ON THE BETHE–SALPETER EQUATION. Sundaresan, M. K. (Carleton Univ., Ottawa); Watson, P. J. S. Ann. Phys. (N. Y.); 71: No. 2, 443-65(Jun 1972).

A model of spinor quarks interacting via simple harmonic interactions in the Bethe–Salpeter equation is considered. By discussion of a number of explicit solutions, it is demonstrated that a large amount of nonrelativistic intuition is wrong for this model of tightly bound systems. A few not implausible quark models and their properties are described: one of these has a reasonably physical mass spectrum and, in addition to satisfying some theoretical prejudices, gives rise to rather natural explanations for the split A_2 and some of the success of calculations with the nonrelativistic quark model. (auth)

44033 ABSORPTIVE EFFECTS IN MULTIPERIPHERAL MODELS. Caneschi, L. (CERN, Geneva); Schwimmer, A. Nucl. Phys.; B44: No. 1, 31-44(1972).

Absorptive corrections to a multiperipheral production amplitude are expected to introduce long-range correlations between the produced particles, and therefore to change substantially the characteristic features of multiperipheralism. The behavior of the partial cross sections and of the inclusive distributions is studied in the absorptive multiperipheral model recently proposed by Finkelstein and Zachariasen, and is compared with the one expected in regular multiperipheralism. (auth)

44034 SPIN STRUCTURE OF HADRONS IN THE COMPOSITE MODEL AND POLARIZATION PHENOMENA. Shirafuji, Tadahiko (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1289-99 (Apr 1972).

A model for reactions of composite hadrons is presented, which introduces the effect of the motion of each urbaryon as a Dirac particle. As a consequence the non-vanishing polarization function $P(\theta, E)$ is obtained even for the forward reactions which receive contributions only from a single one of three diagrams. This result is compared with that of a model which neglects the internal structure of hadrons. (auth)

44035 INCLUSIVE REACTIONS AND URBARYON REARRANGEMENT DIAGRAMS. Noda, Huijo; Kinoshita, Kisei (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1300-21(Apr 1972).

The inclusive reactions $a + b \rightarrow c +$ anything are investigated on the basis of the structure of urbaryon rearrangement diagrams combined with the generalized optical theorem. The dominant production mechanism of single-particle distributions is characterized by three categories mapped onto three types of urbaryon rearrangement diagrams, respectively. The asymptotic form of each production mechanism is discussed, assuming that the structure of the effective energy dependence of hadron reaction amplitudes is specified by the rearranged urbaryon number. The overall picture for the inclusive reactions including the resonance-production region is given. (auth)

44036 MESO-STRONG AND WEAK INTERACTIONS IN THE $SU(3)' \times SU(3)''$ SCHEME OF THE THREE-TRIPLET MODEL. Tsai, S. Y. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1331-42(Apr 1972).

The charm-violating weak interaction is investigated in the $SU(3)' \times SU(3)''$ scheme of the three-triplet model and it is shown that it provides a reasonable framework for describing a new type of processes such as indicated by the recent cosmic ray experiment. It is also pointed out that the charm- and hypercharge-conserving coupling between the two SU(3) groups would necessarily destroy isospin invariance and that the interplay of this "meso-strong" interaction with the weak interaction would give rise to CP violation for strangeness-changing nonleptonic processes. (auth)

44037 MODEL FOR THE BROKEN SU(3) SYMMETRY BASED ON THE NON-LINEAR REALIZATION OF THE GROUP. Okabayashi, Takao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1343-66(Apr 1972).

A composite model based on the non-linear realization of the group SU(3) on its subgroup U(2) is settled. The constituent particles are the nucleon, the pion and the kaon-pair which is a set of the preferred fields in the realization. First the minimal kaon–nucleon interaction is fixed through the classical Lagrangian density for the kaon–nucleon system, which is invariant under the group SU(3) in the sense of our realization. (§2) G-invariance is imposed on the Lagrangian density, but the neutral components of current, which belong to the homogeneous space SU(3)/U(2), have not definite CP parity in general owing to the non-linear character of our realization. Then the current–current type weak interaction with the selection rule $|\Delta I| = 1/2$ and $|\Delta Y| = 1$ can involve the CP violating terms which induce the $K_L^0 - K_S^0$ transition in the second order. (§3) In order to construct baryons as composite systems of the nucleon and the kaon, these fields must be quantized. The particle picture of the kaon is modified to avoid the difficulty in spanning the Fock space before the quantization, and the effective kaon–baryon interactions of the Yukawa type are extracted from the minimal interaction. (§4) The quantization of the modified kaon field as a Klein–Gordon particle introduces a breakdown of the symmetry even if any symmetry violating interaction is not considered. (§6) Further the operator of the composite Λ particle is not invariant under the group in our realization, for example. The pion problem is briefly discussed in §5. (auth)

44038 EXPLANATION OF HELICITY CONSERVATION FROM THE QUARK MODEL AND TENSOR COUPLING. Biyajima, Minoru; Kenmoku, Masakatsu; Minamikawa, Toshiuki (Tokyo Univ. of Education. Tokyo Univ.). Progr. Theor. Phys. (Kyoto)· 47: No. 4, 1418-19(Apr 1972).

Helicity conservation is derived from the quark model and the gluon with gravitation-like coupling. The s-channel helicity conservation coupling is obtained from the energy-momentum tensor of the quark field $\Theta_{\mu\nu} = (\Sigma_\mu \gamma_\nu + \Sigma_\nu \gamma_\mu)/4$, but the t-channel helicity conservation coupling for π-A_1 vertex is not derived from $\Theta_{\mu\nu}$. It is found that $(\Sigma_\mu \Sigma_\nu)$ satisfies the t-channel helicity conservation for π-A_1 vertex for the kinematical supermultiplet model, but not for the oscillator excitation model. (L.B.S.)

44039 SCALING OF INTERACTION RADIUS. Otsuki, Shoichiro (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1440-2(Apr 1972).

The relation between the interaction radius scaling and the urbaryon number for hadrons is examined, and its implications for hadron structure are discussed. (L.B.S.)

44040 PROCEEDINGS OF THE 2nd SYMPOSIUM ON HADRON SPECTROSCOPY, BALATONFUERED, HUNGARY, 6–11 SEPTEMBER 1970. Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 1-276 (1972). (CONF-700937).

Twenty-three papers are included; a separate abstract is prepared for each paper. (L.B.S.)

For abstracts of individual papers see: 43956, 43962, 43963, 44003–44008, 44020–44022, 44041–44043, 44052, 44069, 44092, 44093, 44096, 44124, 44125, and 44149.

44041 POSSIBLE BOOTSTRAP ORIGIN OF MATHEMATICAL QUARKS. Capps, R. H. (Weizmann Inst. of Science, Rehovot, Israel). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 109-22 (1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

A set of self-consistency conditions based on very simple assumptions is derived. The conditions imply that hadrons have a surprising number of quark-model properties. (auth)

44042 PARTON APPROACH TO DUAL MODELS. Olesen, P. (CERN, Geneva). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 123-8(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The problem of correspondence of very high order unrenormalized Feynman diagrams to the dual model is discussed. The very high order Feynman diagrams are investigated using a statistical formalism recently developed. (auth)

44043 SPIN AND UNITARY SPIN IN THE DUAL RESONANCE MODEL. Montvay, I. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 129-37(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The recent developments in constructing dual amplitudes with spins and unitary symmetry are briefly reviewed. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 44062.

44044 (JINR–E2-6350) EVIDENCE FOR NEW SINGULARITIES IN REGGE PHENOMENOLOGY. Efremov, A. V.; Peshanskii, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 28p. Dep. NTIS (U. S. Sales Only).

New fixed singularities at the imaginary axis in the complex l-plane are proposed to overcome the difficulties of Regge phenomenology in the reactions πN-and NN-charge exchange and $K^- p \to \pi^- \Sigma^+$, $\pi^+ p \to K^+ \Sigma^+$. The theoretical arguments in the favor of such singularities are twofold: a scale invariant behavior of "potentials" in Lagrangian field theory (γ^5- and σ-model), a modified absorption correction to the wrong signature poles. The connection of these singularities with the duality is discussed. (auth)

44045 APPLICATION OF CONTINUOUS MOMENT SUM RULES TO $\pi\pi$ SCATTERING. Kaiser, Gerald (Carleton Univ., Ottawa). Nucl. Phys.; B43: 345-54(15 Jun 1972).

Continuous moment sum rules are applied to $\pi\pi$ scattering using phase shifts obtained from π-production data by OPE analysis. The calculation indicates that P, P′ and ρ Regge pole exchanges offer an adequate and consistent description of the available data. The fits suggest that P′ – ρ exchange degeneracy is violated, with P′ choosing no compensation and ρ choosing nonsense. (auth)

44046 LOW-ENERGY PION–PION SCATTERING FROM CURRENT ALGEBRA: UNITARITY CORRECTIONS. Morgan, D. (Rutherford High Energy Lab., Chilton, Eng.); Shaw, Graham. Nucl. Phys.; B43: 365-88(15 Jun 1972).

Unitarity corrections to Weinberg's prediction of low-energy $\pi\pi$ parameters from current algebra are considered. This is done in an explicitly crossing symmetric manner using the variables Q_s, Q_t, Q_u introduced by Iliopolous. It is shown that the corrections over the threshold regions can be included up to third order in the momenta in an essentially unique way. Quartic terms in the respective channel momenta, and hence D-wave effects, are also evaluated in a variety of models. Rigorous inequalities on S-waves are checked and found to be satisfied in both the cubic and quartic cases. While the qualitative picture which results is unchanged by these corrections, some non-negligible quantitative changes result: principally an increase in the I = 0 s-wave parameters compared to the Weinberg values. The results are compared with the present phenomenological evidence. (auth)

44047 LOW-ENERGY AMBIGUITIES OF THE $\pi\pi$ ISOSPIN-ZERO S-WAVE COMPARED WITH πN S-WAVE ANALYSIS. Elvekjaer, F. (Univ. of Aarhus, Denmark). Nucl. Phys.; B43: 445-56(15 Jun 1972).

A method for extracting in a model-independent way a weighted long-range contribution to the πN isospin (+) S-wave is devised. This long-range part is related to the low-energy $\pi\pi$ isospin-zero S-wave phase δ_0^0. Three rather different δ_0^0 phases were investigated, namely (i) the Morgan and Shaw favored solution, (ii) a characteristic UP–UP solution and (iii) a characteristic DOWN–UP solution. The helicity amplitudes $f_+^0(t)$ corresponding to each ansatz for δ_0^0 are compared with our weighted long-range part of πN isospin (+) S-wave partial-wave amplitude. Among the three alternatives considered only the Morgan and Shaw solution (i) above is consistent with the analysis. (auth)

44048 LOWER BOUNDS FOR $\pi\pi \to N\bar{N}$ SCATTERING AMPLITUDES. Kolanowski, M. (Warsaw Univ.); Lukaszuk, L. Nucl. Phys.; B43: 569-78(15 Jun 1972).

A new method of derivation of rigorous lower bounds from the knowledge of the $\pi^\pm p$ total cross sections is presented. The bounds obtained here are close to the phenomenological estimates for the $\pi\pi \to N\bar{N}$ amplitudes. The method applies to the other amplitudes with similar analyticity properties like $\pi\pi \to \pi\pi$, $\pi\pi \to K\bar{K}$ etc. (auth)

44049 GENERALIZATION OF THE NEVEU–SCHWARZ MODEL TO INCLUDE AN ARBITRARY INTERSECTION OF THE ρ TRAJECTORY. Kudryavtsev, V. A. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 15: No. 8, 345-8 (20 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 8, 487-91(20 Apr 1972).

In the constructed model, which generalized the Neveu–Schwarz amplitude for π N-point diagrams to arbitrary $\alpha_\rho(0)$, there is no tachyon on the ρ trajectory, and the contribution of all the states factors out independently of the number of external pions. But the supergauge conditions no longer lead to elimination of ghosts from the spectrum. (J.F.P.)

44050 QUARK-MODEL-LIKE RESULTS FROM DUALITY APPLIED TO VECTOR-MESON SCATTERING. Caprini, I.; Micu, L. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 2, 147-54(1972).

The consequences of the absence of second-kind exotic resonances in $\omega\rho$, $\Phi\rho$ and $\Phi\omega$ scattering are investigated from the point of view of duality on a whole t range around t = 0. Using Leader's constraints for the Regge residues at t = 0 together with SU(3) symmetry, canonical mixing angles for the exchanged and external particles are found. (auth)

44051 TRILINEAR COUPLING OF SCALAR BOSONS IN THE SMALL MASS LIMIT. Veneziano, G. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; B44: No. 1, 142-8(1972).

An S-matrix argument, as well as a field-theoretical argument, suggests that the trilinear coupling of a scalar particle of mass μ has to vanish, at least like μ, for $\mu \to 0$. (auth)

44052 OFF-MASS-SHELL CONTINUATION OF THE VENEZIANO MODEL. Csikor, F. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 139-46(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The problem of incorporation of currents into the Veneziano model is studied. The case of axial vector current is treated in detail on the example of the off-shell $\pi\pi \to \pi\pi$, $A_\mu \pi \to \pi\pi$ and $A_\mu \pi \to A_\mu \pi$ processes. (auth)

Strong (Baryon No. = 1)

44053 (JINR – E2-6455) NONET DOMINANCE AND ISOSPIN CONSTRAINTS ON μ-PAIR AND W-BOSON PRODUCTION. Kunszt, Z.; Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 12p. Dep. NTIS (U. S. Sales Only).

The processes $N(\pi) + N \to \mu^+\mu^-(W^\pm)$ + hadrons are considered. Inequalities are given which follow from the isospin invariance of the hadronic states, the nonet assignment of the electromagnetic and weak currents of hadrons and the nonet dominance of the products of these currents as it is suggested by the light-cone algebra of Fritzsch and Gell–Mann. The inequalities are expected to be valid at high photon and W-boson masses. (auth)

44054 DUALITY AND SU(3) FOR MESON–BARYON RESONANCES AND HIGH-ENERGY FORWARD SCATTERING. Hirshfeld, A. C. (Univ., Heidelberg). Z. Phys.; 252: No. 3, 255–82 (1972).

The degeneracy structure of Regge trajectories and residues in meson–baryon scattering amplitudes which results from non-exoticism in a dual SU(3) picture is discussed. Plots of universal baryon residue functions are presented, which show to what extent this structure is realized by the experimental baryon resonances. The EXD structure of the Regge trajectories in the mesonic t-channel is tested in the high-energy forward scattering region. Fits to the experimental data, including weak absorption corrections, are presented. A value of F/D ~ ⅓ for the A-Amplitude, and a suppressed A′, are found to be consistent with both the resonance and scattering data. A common description of the high-energy and low-energy data is sought in terms of a five parameter Veneziano amplitude. (auth)

44055 K^+p DISPERSION RELATIONS. I. SCATTERING BELOW 1.3 GeV/c. Martin, B. R. (NORDITA, Copenhagen. University Coll., London); Miller, C. E. Nucl. Phys.; B43: 157-77 (15 Jun 1972).

An investigation of K^+p scattering was made using the techniques of dispersion theory. A phase-shift analysis of data below 1.3 GeV/c was performed using parameterized partial-wave dispersion relations. A unique physical solution was found, but this could be realized by a number of different sets of exchange forces. By examining the self consistency of the solutions with backward-angle K^+p dispersion relations, preferred solutions were obtained. Some brief remarks on the dynamics of low-energy K^+p scattering implied by these solutions are made. (auth)

44056 DUALITY AND DIPS IN $\pi p \rightarrow \pi\Delta$ AND $\eta\Delta$. Gell, Y. (Tel-Aviv Univ., Israel). Nucl. Phys.; B43: 189-204(15 Jun 1972).

The consistency of local duality with the locations of zeroes of the helicity amplitudes describing the $\pi^+p \rightarrow \pi^0\Delta^{++}$ and $\pi^+p \rightarrow \eta\Delta^{++}$ systems is studied. The predictive consequences of this study are evaluated and a comparison with the Δ^{++} density matrix data and the results of the Stodolsky–Sakurai model is given. (auth)

44057 POLARIZATION RELATIONS IN CHARGE AND HYPERCHARGE EXCHANGE REACTIONS. Martin, A. D. (CERN, Geneva); Michael, C.; Phillips, R. J. N. Nucl. Phys.; B43: 13-26 (15 Jun 1972).

Relations between polarizations in charge and hypercharge exchange reactions are derived. The idea is that K*(890) and K**(1400) exchanges, including unspecified absorptive corrections, are related to ρ and A_2 exchanges by SU(3) octet symmetry, with a scale factor to represent symmetry breaking between the ρ–A_2 and the K*–K** trajectories. This hypothesis is consistent with the present data on $\bar{K}N \rightarrow \pi\Sigma(\pi\Lambda)$ and $\pi N \rightarrow K\Sigma(K\Lambda)$. It leads to simple relations between the polarized cross sections P $d\sigma/dt$, relating the above reactions to $K^-p \rightarrow \bar{K}^0n$, $K^+n \rightarrow K^0p$, $\pi^-p \rightarrow \pi^0n$, $\pi^-p \rightarrow \eta^0n$. Predictions are made, on this basis, for polarization in $K^-p \rightarrow K^0n$, $K^+n \rightarrow K^0p$ and $\pi^-p \rightarrow \eta^0n$ at 4 GeV/c and for $K^-p \rightarrow \bar{K}^0n$ at 7 GeV/c. Finally, some supplementary conjectures lead to predictions about polarization in baryon–baryon and baryon–anti-baryon reactions, $np \rightarrow pn$, $\bar{p}p \rightarrow \bar{n}n$, $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$, etc., and also in $K_L^0p \rightarrow K_S^0p$ regeneration. (auth)

44058 SUCCESSES AND FAILURES OF DUAL ABSORPTION MODELS. Barger, .V.; Halzen, F. (Univ. of Wisconsin, Madison). Nucl. Phys.; B43: 62-76(15 Jun 1972).

The peripherality assumption of dual absorption models is examined in the case of elastic scattering. Data on differential cross sections sums $(d\sigma/dt)(\bar{A}B) + (d\sigma/dt)(AB)$ exclude a peripheral character for the energy dependent part, casting serious doubts on the validity of the two component theory of the Pomeron. Analyses of the differences $(d\sigma/dt)(\bar{A}B) - (d\sigma/dt)(AB)$ as a function of both t and s are consistent with a peripheral $J_0(R\sqrt{-t})s^{n-1}$ structure for the imaginary parts of the helicity non-flip ρ exchange in πN and ω-exchange in KN. The non-flip ω-amplitude in NN has a different structure than that expected from simple peripherality. A relation between K^+p and K^-p polarization derived from exchange degeneracy for the helicity flip amplitude is in qualitative accord with data. Regge–Regge interference terms are proposed as possible explanation of the double zero around $t \simeq -0.8$ in pp polarization. (auth)

44059 U(6,6) ⊗ O(3,1) PERIPHERAL ABSORPTION MODEL AND THE PRODUCTION OF 2^+ AND 1^+ MESONS. Gujadhur, T. K.; Migneron, R.; Moriarity, K. J. M. (Imperial Coll. of Science and Tech., London) Nucl. Phys.; B43: 253-71(15 Jun 1972).

The peripheral model incorporating U(6,6) ⊗ O(3,1) couplings is applied to the production of 2^+ and 1^+ mesons in pion–nucleon and kaon–nucleon collisions at intermediate energies. The agreement with experiment is good where pion exchange is the dominant mechanism and fails for the other reactions. (auth)

44060 SINGLE-PARTICLE DISTRIBUTIONS AND MULTIPARTICLE CORRELATIONS IN INCLUSIVE EXPERIMENTS. Bialas, A. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow); Fialkowski, K.; Wit, R. Nucl. Phys.; B43: 413-33 (15 Jun 1972).

The relations between the two- and three-particle correlation functions and the single-particle distributions measured in inclusive experiments are presented in some detail. It is suggested that these relations can be used to study the correlations among particles. As an example, the correlations among the negative pions produced in K^+p, π^+p and pp inclusive experiments in the energy region from 12 to 28 GeV are investigated in this way. It is shown that strong two- and three-particle correlations exist. The observed detailed behavior is discussed in terms of current theoretical models. In particular, it is shown that the scaling limit is not reached in the considered energy range. (auth)

44061 REGGE FIT WITH VENEZIANO RESIDUES TO $K^\pm p$ SCATTERING. O'Hara, D. W.; Squires, E. J. (Univ. of Durham, Eng.). Nucl. Phys.; B43: 470-6(15 Jun 1972).

A simple parametrization of Regge residues, based on a linear combination of two Veneziano terms, is fitted to available $K^\pm p$ differential cross section and polarization data. Good agreement is obtained. The resulting amplitudes show evidence of t-channel helicity conservation for the pomeron contribution and they agree remarkably well with the results of a phase shift analysis at lower energy. (auth)

44062 PUZZLES OF ELEMENTARY-PARTICLE SPECTROSCOPY. Shirkov, D. V. (Inst. of Mathematics, Novosibirsk, USSR). pp 327–40 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The hadron mass spectra are treated from the viewpoints of the quark model and Regge pole theory. (J.F.P.)

44063 PREDICTIONS FOR INCLUSIVE REACTIONS BASED ON A PARTON STRUCTURE OF HADRONS. Goldberg, Hyman (Northeastern Univ., Boston). Nucl. Phys.; B44: No. 1, 149-56 (1972).

It is proposed that the asymptotic single-particle distributions $f(x) = x(d\sigma/dx)$ in inclusive reactions should reflect the limiting longitudinal momentum distribution, $\sim\nu W_2(x)$, of the hypothetical partons constituting a hadron. It is further argued that f(x) becomes proportional to $\nu W_2(x)$ as $x \rightarrow 1$. Predictions are then made for a large class of inclusive reactions based on our knowledge of $\nu W_2(x)$ from the electroproduction data. For some of these (such as $pp \rightarrow \pi^\pm X$), in which the predictions differ markedly from the Regge ones, present experiments distinctly favor ours. (auth)

44064 REAL PARTS OF SCATTERING AMPLITUDES AND REGGE PHENOMENOLOGY. Coirier, M. F.; Guillaume, J. L.; Leroyer, Y.; Salin, Ph. (Univ., Bordeaux). Nucl. Phys.; B44: No. 1, 157-70(1972).

High energy scattering amplitudes are computed using the Harari model for the imaginary parts and fixed t dispersion relations for the real parts. This procedure induces a corrective term to the real part of the Regge amplitudes whose effects are investigated in π-nucleon and K-nucleon charge exchange reactions. (auth)

44065 FEATURES OF PARTIAL WAVES IN πN CHARGE EXCHANGE SCATTERING AT 6 GeV/c. Hoegaasen, H. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France); Michael, C. Nucl. Phys.; B44: No. 1, 214-20(1972).

From the result of amplitude analyses and Regge fits an attempt is made to determine the structure of the partial wave amplitudes in πN charge exchange. Significant high-J contributions to $\mathrm{Im} f_{++}$ are found which are in conflict with usual absorbed dual Regge models. (auth)

44066 THEORETICAL ANALYSIS CONCERNING RESONANCE COUPLINGS IN THE REACTION $\pi N \rightarrow \pi\Delta$. York, M. J. (Univ. of Lancaster, Eng.). Nucl. Phys.; B44: No. 1, 253-68(1972).

Unsubtracted fixed-t dispersion relations are used to calculate the real parts of partial waves in the reaction $\pi N \rightarrow \pi\Delta$. Unitarity limits on these real parts are used to predict the $\pi\Delta\Delta$ (p-wave) coupling and the $N'_\alpha(\frac{1}{2}^+)(1467)$ reduced coupling to $\pi\Delta$. Besides the N'_α, the $N_\beta(\frac{5}{2}^-)(1673)$ is predicted to be a prominent resonance. There is some evidence that the $N''_\alpha(\frac{1}{2}^+)(1755)$ and $\Delta'_\delta(\frac{3}{2}^+)(1717)$ may also couple significantly to the $\pi\Delta$ channel. The situation regarding other low energy resonances is very uncertain in this analysis. (auth)

44067 POLARISATION IN $\pi^-p \rightarrow K^0\Lambda^0$ BACKWARD SCATTERING AT HIGH ENERGY. Schmid, C. (CERN, Geneva); Storrow, J. K. Nucl. Phys.; B44: No. 1, 269-87(1972).

The sign of the polarization in backward $\pi^-p \rightarrow K^0\Lambda^0$ high energy scattering is predicted in a parameter-free Regge model with exchange degenerate $\Sigma_\alpha - \Sigma_\gamma$ and $\Sigma_\delta - \Sigma_\beta$ poles. The sign prediction depends on (i) the sign of the Regge phase difference between $\Sigma_\alpha\Sigma_\gamma$ and $\Sigma_\beta\Sigma_\delta$, which is 90°, (ii) the [SU(3)] sign of the Y* resonance couplings determined experimentally in the crossed channel $\bar{K}N \rightarrow \pi\Lambda$, (iii) the simple connection between the sign of the nonflip/flip ratio and the parity of the exchanged baryon. The large magnitude of the experimental polarization, ≃100%, is explained naturally by the 90° difference in the Regge phase and the opposite sign of $j-l = \pm\frac{1}{2}$ for $\Sigma_\alpha\Sigma_\gamma$ and $\Sigma_\beta\Sigma_\delta$. (auth)

44068 $F_1(1540)$: KINEMATIC ENHANCEMENT AND RESONANCE. Griffiths, D.; Saperstein, A. M.; Schnitzler, D. T. (Wayne State Univ., Detroit). Nucl. Phys.; B44: No. 1, 21-30 (1972).

The F_1 (1540) enhancement was observed in the process $\pi p \rightarrow K^*Kp$ and also in $p\bar{p} \rightarrow K^*K\pi$. It is shown that in $\pi p \rightarrow K^*Kp$ it can be explained, via the Reggeized Deck model, as a kinematic enhancement. In $p\bar{p} \rightarrow K^*K\pi$ it is most easily explained as a resonance. An estimate of the expected $\rho\pi$ and $\omega\pi$ decay modes of the F_1 indicates that its G-parity cannot be determined, in the usual way, by observing these decays. It is pointed out that further experiments on $\pi p \rightarrow K^*Kp$ at higher energies can determine the G-parity which should be negative if the Deck model is valid. If the kinematic enhancement explanation is still valid at these higher energies, then the fact that the F_1 is also seen in $p\bar{p} \rightarrow K^*K\pi$ will give added credence to the conjecture of Chew and Pignotti that an enhancement produced by the Reggeized Deck calculation implies the existence of a resonance. (auth)

44069 OMEGA–RHO INTERFERENCE IN STRONG INTERACTIONS. Roos, M. (CERN, Geneva). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 215-39(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

Phenomenological formalism for $\omega-\rho$ mixing is given and its effect on strong interaction is discussed in many reactions. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 44221.

44070 (COO–3130–TA–261) SINGLE PARTICLE DISTRIBUTIONS IN A HADRONIC BREMSSTRAHLUNG MODEL. Fried, H. M. (Brown Univ., Providence, R. I. Dept. of Physics); Gaisser, T. K. (Bartol Research Foundation, Swarthmore, Pa.). 1972. 51p. Dep. NTIS.

It is shown that the inclusive cross section for production of a single soft, neutral vector meson in pp scattering vanishes like 1/s at $p_{||}/p_{||\max} = 0$ in the center of mass for mesons radiated from the external nucleon legs. Comparison of the resulting single pion distribution with the ISR data make it unlikely that the data in the pionization region can be understood in a conventional bremsstrahlung picture. (auth)

44071 FEATURES OF HADRON COLLISIONS COMPARED TO THE PREDICTIONS OF p_T LIMITED PHASE SPACE. Feinberg, S.; Grunhaus, J. (Tel-Aviv Univ., Israel). Nucl. Phys.; B43: 147-56(15 Jun 1972).

Features of a p_T limited phase space are discussed and compared with the experimental data for pp, K^+p, and $\pi^\pm p$ reactions. A good description of the energy dependence of the cross sections is achieved by means of a simple model which uses p_T fixed longitudinal momentum phase space. The combined c.m. p_L distribution for all outgoing pions in π^-p reactions at 16 GeV/c and π^+p reactions at 8 GeV/c is shown to be well described by a p_T fixed longitudinal phase space distribution. (auth)

44072 $U(6,6) \otimes O(3,1)$ PERIPHERAL ABSORPTION MODEL AND PRODUCTION OF THE $\frac{5}{2}^+$ NUCLEON RESONANCE. Gujadhur, T. K.; Migneron, R.; Moriarty, K. J. M. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B43: 272-8(15 Jun 1972).

The peripheral absorption model within $U(6,6) \otimes O(3,1)$ symmetry scheme is applied to the production of the $\frac{5}{2}^+$ in proton–proton collision at 5.5 GeV/c. Only pion exchange is considered; good agreement is obtained with experiment. (auth)

44073 NUCLEON–NUCEON SCATTERING IN THE LINEAR σ-MODEL. Graffi, S. (Istituto Nazionale di Fisica Nucleare, Bologna); Grecchi, V.; Turchetti, G. Lett. Nuovo Cim.; 4: No. 7, 281-7(17 Jun 1972).

The linear σ-model used to compute a unitary approximation to the NN amplitude is examined and its phenomenological implications are discussed. The comparison between the Yukawa model, the nonlinear σ-model, and the linear σ-model for various sets of partial waves is presented. (L.B.S.)

44074 NUCLEON RESONANCE PRODUCTION IN HIGH-ENERGY pp COLLISIONS. Parry, D. E. (Oxford Univ.). Lett. Nuovo Cim.; 4: No. 7, 267-73(17 Jun 1972).

The differential cross sections for elastic scattering and production of N*(1400) and N*(1690) in high-energy pp interactions are evaluated using quark amplitudes and shell-model wave functions given by the symmetric harmonic oscillator model for the three-quark system. The results are compared with experimental data. (L.B.S.)

44075 NONSTATIC NUCLEAR FORCES OF THE TRIPLET STATE IN MOMENTUM SPACE. Wada, Masanobu (Nihon Univ., Funabashi, Japan). Progr. Theor. Phys. (Kyoto); 47: No. 2, 535-55(Feb 1972).

The nucleon–nucleon scattering in the uncoupled triplet states is described by the one-boson-exchange model in conjunction with the Schroedinger equation in momentum representation. The nonstatic matrix elements due to the exchange of π, ω, ρ and an isoscalar scalar meson are obtained. The nonstatic nuclear forces in momentum space are discussed in detail in connection with the LS force and the velocity-dependent term in coordinate space. Also the behavior of $^3P_0$ phase shift at 25 to 50 MeV is especially discussed. The meson coupling constants are adjusted to fit the experimentally determined phase shifts. The phase shifts obtained from the momentum-space calculations are in reasonable quantitative agreement with those obtained from the phase-shift analysis. (auth)

44076 $NN\pi$ FORM FACTOR AND THE GOLDBERGER–TREIMAN RELATION. Braathen, H. J. (NORDITA, Copenhagen). Nucl. Phys.; B44: No. 1, 93-109(1972).

The nucleon–nucleon–pion form factor is calculated as a function of the square of momentum exchange in two different models; the σ-model, and one in which ρ and ϵ exchanges only are taken into account. The results are compared with experiments through the corrections to the Goldberger–Treiman relation. Approximately 40% of the corrections can be explained in terms of a one-loop approximation in our models. (auth)

44077 NEW MODEL FOR PARTICLE MULTIPLICITIES IN STRONG INTERACTION PRODUCTION PROCESSES. Kaiser, G. D. (Daresbury Nuclear Physics Lab., Warrington, Eng.). Nucl. Phys.; B44: No. 1, 171-88(1972).

A new model is proposed for the description of the cross sections for the production of j charged pairs: $\sigma(j) = C \exp(-(j-m)^2/2\sigma^2)/\Sigma_j \exp(-(j-m)^2/2\sigma^2)$. The derivation is based on an application of the central limit theorem of probability. The model agrees well with the available data. It is shown that charge conservation and isospin conservation can be built into the model in a simple way. It is also shown that the given formula removes ambiguities of choice of variable that arise when discussing e.g., the Poisson distribution. The model includes the elastic cross section in its description of events with no charged pair production. (auth)

44078 PROTON–PROTON SCATTERING AND URBARYON REARRANGEMENT. Imachi, Masahiro; Oroguchi, Takashige; Otsuki, Shoichiro (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1448-9(Apr 1972).

Elastic pp scattering is investigated from the viewpoint that dynamic aspects of hadron reactions correspond to the pattern of urbaryon rearrangement diagram (URD). Three N–N amplitudes f^D, f^x, and f^{xd}, corresponding to three types of URD, are considered. Qualitative arguments are given that (i) the break of $d\sigma/dt|_{90°}$ manifests a shift of dominant contribution from f^x to f^{xd} and (ii) the shoulder-like structure of $d\sigma/dt$ is a consequence of antisymmetrization for f^x and f^{xd}. (L.B.S.)

44079 PHENOMENOLOGICAL ANALYSIS OF NUCLEON–NUCLEON SCATTERING AT ABOUT 6 GeV. Sato, Sukeyo; Ueda, Tamotsu (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1235-46(Apr 1972).

This is a phenomenological analysis of proton-proton and proton-neutron scattering at about 6 GeV. Our viewpoint is that fundamental mechanisms for the nucleon-nucleon interaction are absorption for an imaginary amplitude and one-boson-exchange for a real amplitude. A model is constructed which reproduces satisfactorily all the available nucleon-nucleon data at 6 GeV, and it is pointed out that the one-boson-exchange amplitude has an applicability to the description of spin-variable and isospin-variable dependence of the amplitude at high energy. An absorptive contribution from N^*-production is suggested as well as from uncorrelated multi-meson production. Isospin exchange effect in high energy scattering is also discussed. (auth)

Particle Invariance Principles and Symmetries

Refer also to abstract 42832.

General

Refer also to abstract 44128.

44080 TIME REVERSAL. Sachs, Robert G. (Univ. of Chicago). Science; 176: No. 4035, 587-97(12 May 1972).

The significance of recent measurements which provide direct or indirect evidence of time reversal is discussed. The limitations of the decay measurements are pointed out. It is suggested that the use of high-energy neutrino beams will provide the first opportunity to determine whether there is a connection between the nature of measurements over small space—time intervals and the existence of a violation of the time-reversal principle. (L.B.S.)

44081 COUPLING PROBLEM FOR INFINITE MULTIPLETS. Verde, M. (Univ., Turin). pp 305-15 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

Some results obtained in the explicit evaluation of the matrix elements of the product of three infinite multiplets of 0(2,1) and a treatment of all their symmetry properties are discussed. Applications mentioned are atomic hydrogen and nuclear and particle structure. (J.F.P.)

44082 PARITY, CHARGE CONJUGATION, AND TIME REVERSAL. Dalitz, R. H. (Oxford Univ.). pp 341-75 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 969).

A review of invariance principles is given covering parity, charge conjugation, CP invariance, the neutrino, time reversal, the operation CPT, and the neutral K mesons and CP violation. (J.F.P.)

44083 MANIFESTLY CONFORMAL-COVARIANT EXPANSION ON THE LIGHT CONE. Ferrara, S. (CNEN, Frascati, Italy); Grillo, A. F.; Gatto, R. Phys. Rev., D; 5: No. 12, 3102-8(15 Jun 1972).

The isomorphism of the conformal algebra on space—time to the orthogonal O(4,2) algebra is exploited to derive in a manifestly covariant way an operator-product expansion on the light cone in terms of irreducible operator representations of the conformal algebra. The expansion provides for a solution of the causality problem for operator expansion on the light cone. Additional properties of the conformally covariant expansion, as well as its relation to the conformally invariant three-point function, are discussed. (auth)

44084 BREAKING OF CONFORMAL SYMMETRY AND RENORMALIZATION OF NON-POLYNOMIAL THEORIES. Salam, A. (Imperial Coll. of Science and Tech., London. International Centre for Theoretical Physics, Miramare, Italy). Fields Quanta; 1: N No. 1, 1-32(Oct 1970).

The non-linear realizations of the conformal group and the group of general relativity are considered. The general problem of non-polynomial Lagrangians is reviewed. In particular it is shown that the non-polynomial, non-linear Lagrangian theories do not appear to suffer from the ultraviolet infinities of the usual polynomial Lagrangian theories. The relativistic theory of gravitation is included in this discussion of non-linear non-polynomial theories since, when this theory is taken into account as a quantum theory, it appears possible that all infinities still surviving in renormalized theories like quantum electrodynamics will disappear. This result is shown from explicit calculations with models. (auth)

44085 ADVANCES IN THE APPLICATION OF SYMMETRY. Ne'eman, Y. (Tel Aviv Univ., Israel. Univ. of Texas, Austin). Fields Quanta; 1: No. 1, 55-92(Oct 1970).

The accomplishments of the past decade in the application of symmetry methods to the phenomena of particle physics are reviewed. After reviewing the impact of the development of algebraic methods from the earlier group methods, the meaning of invariance and classification in this broader context is reviewed. The known symmetries and their interpretation in quark models are then described. The use of higher symmetries in particle physics is investigated. (auth)

44086 SYMMETRY BREAKDOWN AND SMALL MASS BOSONS. Nambu, Yoichiro (Univ. of Chicago). Fields Quanta; 1: No. 1, 33-54(Oct 1970).

The meaning and mechanism for spontaneous breakdown of a symmetry are reviewed. After reviewing the history of the Goldstone boson, the relationship of the Goldstone theories to PCAC, current algebra, and soft pion limits is described. These problems are unified in the approach of utilizing the non-linear realizations of the symmetries. (auth)

44087 THEORY OF THE CONFORMALLY INVARIANT MASS. Barut, A. O.; Haugen, Rolf B. (Univ. of Colorado, Boulder). Ann. Phys. (N. Y.); 71: No. 2, 519-41(Jun 1972).

By interpreting the conformal transformations as space—time-dependent change of units and introducing the concept of the conformally invariant mass and charge, new conformally invariant Maxwell equations with source terms and equations of motion for massive particles are developed. Although the usual equations of motion with mass terms break the conformal symmetry, it is shown that the Minkowski space is not the most general framework to describe physical processes and there exists a wider consistent dynamics in which conformal invariance is exact. New results also include the general transformation laws of the electromagnetic fields, of currents and force densities. The theory leads naturally to an affine connection and to the 21-parameter inhomogeneous conformal group, ISO(4,2). (auth)

44088 REPRESENTATIONS OF THE POINCARE GROUP AS FUNCTIONS OF THE EIGENVALUES OF CASIMIR OPERATORS. Szego, K.; Toth, K. (Central Research Inst. for Physics, Budapest). Ann. Phys. (N. Y.); 71: No. 2, 303-18(Jun 1972).

Explicit basis functions are defined for the Poincaré group. Both these functions and the representation matrix elements are continuous functions of the momentum variables for the whole real p^2 spectrum, including the $p^2 = 0$ point. The essence of the method is to enlarge previously obtained SL(2,C) basis functions and representations of a similar nature. (auth)

44089 SYMMETRIES IN ELEMENTARY PARTICLE PHYSICS. Gourdin, Michel (Paris Univ., Orsay, France). Recherche (Paris); 3: No. 21, 243-60(Mar 1972). (In French).

Elementary particle studies have revealed regularities and symmetries enabling accurate experimentally verifiable predictions to be made. The hierarchy established between the different types of exact or approximate symmetries is demonstrated, together with the way in which particles discovered up until the present day can be represented. The symmetries do not determine the interaction dynamics, but limit the number of possible interactions. (France)

44090 UNITARY STATISTICAL WEIGHTS. Nicorovici, N. (Inst. for Atomic Physics, Bucharest). Nucl. Phys.; B44: No. 1, 321-32(1972).

The statistical weight for an n-particle system, characterized by an incomplete set of parameters, is carried out using the SU(3) symmetry model. The method to be used in order to obtain the similar quantities in the SU(6) symmetry model is also indicated. (auth)

44091 NEW EVENT IN COSMIC RAY SHOWERS AND THE U(4) STRANGE SPIN FORMALISM. Suzuki, Tsuneo; Senju, Hirofumi (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1322-30(Apr 1972).

The previous U(4) model (strange spin formalism) in which strangeness has a spin property is reexamined and developed in connection with the new event recently detected by Niu et al. Some undesirable features in the previous paper are improved. It is emphasized that two new conservation rules may be very important in strong interaction: one is that of the new additive quantum number which explains the curious event in cosmic ray experiments and the other is that of the new spin (strange spin) which accounts for the experimental suppression of ϕ in production reactions and of the decay modes $\phi \to \rho\pi$ and $f' \to \pi\pi$. From the viewpoint of this model it is shown that the observed new particle may be identified with a member of the strange 0^- mesons which does not belong to the ordinary octets in the framework of the $\{15\}$ multiplet. (auth)

44092 SCALE INVARIANCE, GOLDSTONE BOSONS, AND THE f' TRAJECTORY. Fujii, Y. (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 75-84(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

It is proposed that the f′ trajectory at $\alpha_{f'} = 0$ can serve the role of a Goldstone boson for scale invariance and experimental consequences that follow from such an association are discussed. (auth)

44093 SOME REMARKS ON ENERGY-DEPENDENT REPRESENTATIONS. Szego, K.; Toth, K. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 147-51(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

After explaining the meaning of energy dependent representation, an outline is given of how it can be obtained for the case of SL (2, C) group. Some physical applications are also treated. (auth)

Applications (Electromagnetic and Weak)

44094 (JINR–E2-6472) $\eta \to 3\pi$ DECAY AND $\pi\eta$ SCATTERING IN CHIRAL $SU_2 \times SU_2$ SYMMETRY. Ivanov, E. A.; Zupnik, B. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Theoretical Physics). 1972. 17p. Dep. NTIS (U. S. Sales Only).

The problem of the $\eta \to 3\pi$ decay in chiral $SU_2 \times SU_2$ symmetry is investigated. It is argued that the well known difficulties of conventional pole model originate from underestimating the role of the η-meson pole graph. This model is shown to be suitable to describe the $\eta \to 3\pi$ decay: with a reasonable choice of the $\pi^0 - \eta$ transition constant $|g_{\pi\eta}| \sim 0.05$ the experimental data on both decay widths and energy spectrum can be satisfied by fitting the parameter of $\pi\eta\pi\eta$-vertex in the η-pole graph. The analysis leads to predictions for the s- and p-wave $\pi\eta$-scattering lengths $|a^0_{\pi\eta}| \sim 0.2\ m_\pi^{-1}$; $|a^1_{\pi\eta}| \sim 0.1\ m_\pi^{-3}$. (auth)

44095 MODEL OF WEAK- AND ELECTROMAGNETIC-INTERACTION SYMMETRY. Tanaka, K. (Inst. of Theoretical Physics, Goteborg. Ohio State Univ., Columbus). Phys. Rev., D; 5: No. 12, 3243-6(15 Jun 1972).

A model that unites the intermediate boson of the weak interaction and the photon of the electromagnetic interaction into a multiplet of gauge fields is considered. Weak leptonic currents and hadronic Cabibbo currents are handled in a parallel manner and generate an SU(2) symmetry group. It is suggested how the K-spin-triplet hypothesis emerges from such an approach. The symmetry between the weak and electromagnetic interaction is spontaneously broken resulting in a massive electron and an intermediate boson. (auth)

44096 SYMMETRY OF LEPTONS. Nakamura, S. (Max-Planck-Inst. for Physics and Astrophysics, Munich); Sato, S. Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 193-213(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

By assuming that (ν_e, e^-) and (μ^+, ν_μ) belong to the spinor representations $\vartheta_{½,0}$ and $\vartheta_{0,½}$ of the rotation group of SU(2) × SU(2), the selection rules for isospin τ and hypercharge spin ξ are formulated for the pure leptonic processes. As a result, self-current processes such as $\nu_e(\tilde{\nu}_e) + e^- \to \nu_e(\tilde{\nu}_e) + e^-$ belong to the allowed transition, while $\mu - e$ exchange processes such as $\mu^\pm \to e^\pm + \nu_e(\tilde{\nu}_e) + \nu_\mu(\tilde{\nu}_\mu)$ belong to the forbidden transition. Leptonic bosons are introduced which are responsible for the mediation of the pure leptonic processes, and their masses and coupling constants are inferred: $M_L \cong 130$ BeV ~ 200 BeV, $G_L^2/4\pi \cong 1 \cdot 10^{-1}$, and $F_L^2/4\pi \cong 1 \cdot 10^{-3}$.

Applications (Strong)

Refer also to abstract 44050.

44097 THEORY OF HADRON STRENGTHS AND CURRENTS. Ne'eman, Y. (Tel-Aviv Univ., Israel). Nucl. Phys.; B43: 623-33(15 Jun 1972).

A theory is proposed in which both low and high energy quark-model and supermultiplet (SU(6) and larger groups) results derive from an algebra of Regge pole vertex-strengths $R[U(6) \times U(6)]_\beta$, whose generators are not the space integrals of current components as had previously been suggested. An RU(6) subgroup can then be localized, thus allowing for calculation of non-forward scattering matrix-elements. (auth)

44098 WIGNER SUPERMULTIPLET BASES. Ahmed, K.; Sharp, R. T. (McGill Univ., Montreal). Ann. Phys. (N. Y.); 71: No. 2, 421-37(Jun 1972).

Two sets of basis states are constructed for the Wigner supermultiplet scheme, $SU(4) \supset SU(2) \times SU(2)$. The first are analogous to the $SU(3) \supset O(3)$ basis states of Bargmann and Moshinsky; they are defined by identifying them with products of powers of certain elementary multiplets. The second are the analogs of the $SU(3) \supset O(3)$ states of Elliott and Harvey; they are obtained by projecting good $SU(2) \times SU(2)$ states out of certain simple intrinsic states. The transformation matrix from the second set of states to the first is given. (auth)

44099 EFFECT OF WEAK INTERACTIONS ON THE BREAKING OF HADRONIC INTERNAL SYMMETRY. Pegoraro, F. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France. Scuola Normale Superiore, Pisa, Italy); Subba Rao, J. Nucl. Phys.; B44: No. 1, 221-35(1972).

The breaking of hadronic internal symmetry by terms which belong to different irreducible representations of $SU(3) \otimes SU(3)$ is examined. The work of Michel and Radicati is extended, and it is found that if $H = H_0 + E(u_0 + cu_8 + du_3) + GH_w + eJ_\mu^{em} A_\mu + H_L + H_{em}$, the breaking terms have interesting mathematical properties. These terms are, in fact, special solutions of algebraic equations, but not for all c and d. It is found that for $u_0 + cu_8 + du_3$ to be one of these solutions, the relation $(\sqrt{2 + c})/\sqrt{3} = -d$ with $d \neq 0$. (auth)

Field Theories

General

Refer also to abstract 44087.

44100 AXIALLY SYMMETRIC ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY. Misra, M.; Trivedi, V. M. (Gujarat Univ., Ahmedabad, India). Curr. Sci. (India); 41: No. 13, 503-4(5 Jul 1972).

It is found that in order to solve the field equations with only one component $F_{12} = F_{21}$ of the electromagnetic field tensor F_{ij} then the field equations require that $F_{12} = 0$. This means that one cannot have a solution corresponding to a magnetic field in the z direction. (J.F.P.)

Quantum Field Theory

Refer also to abstract 44084.

44101 RECOVERY OF THE LIE IDENTITIES OF FIELD THEORY FROM MINIMAL CONDITIONS. Joseph, A. (Tel Aviv Univ., Ramat-Aviv, Israel). Nucl. Phys.; B43: 107-18(15 Jun 1972).

The Lie algebraic structure of the commutation bracket in quantum field theory is examined in a novel setting. A commutator is abstracted from a simple model field theory and then within its general structure is allowed to be quite arbitrary. It is then shown by formal calculation that the Lie identities can be recovered if only the translational invariance of integration is assumed and two extremely weak properties of the forward and backward propagators. These have the interpretation that backward propagation is the reverse of forward propagation and a loop of purely forward propagation vanishes. If Lorentz invariance is further imposed these are shown to imply local commutativity. The use of formal calculation is justified through the fact that the propagators are essentially arbitrary functions. The significance and generality of the results obtained are discussed. (auth)

44102 COMPLEX MASSES AND ACAUSAL PROPAGATION IN FIELD THEORY. Marques, G. C. (Instituto de Fisica, Sao Paulo, Brazil); Swieca, J. A. Nucl. Phys.; B43: 205-27(15 Jun 1972).

It is shown that in formulating a field theory with complex masses, keeping much closer to a detailed space–time description than existing treatments, one is naturally led to a modified Yang–Feldman equation. A consistent interpretation emerges, in which the complex masses are not associated with particles, but with a modification of the field propagation law, which becomes acausal. The indefinite metric of the usual treatments plays no role here. An investigation of both the case of interaction with an external potential, and of the fully quantized theory is carried out. No unitarity, or Lorentz invariance troubles arise, but in the case of a fully quantized theory, the contribution of virtual states with arbitrarily high energy, leads to an enhancement of the basic acausality of the propagation law, in a way that may lead to macroscopic deviations from causality. (auth)

44103 CONSTRUCTION OF NONLOCAL QUANTUM ELECTRODYNAMICS. Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Ann. Phys. (N. Y.); 71: No. 2, 466-85 (Jun 1972).

The perturbation theory of electromagnetic interactions is considered. A hypothesis is proposed that the electromagnetic potential $A_\mu(x)$ is connected with the local fermion current $J_\mu = \bar{\psi}\gamma_\mu\psi(x)$ by a nonlocal form factor $L = e \int \int dx\, dy\, A_\mu(x)\, K(x - y)\, J_\mu(y)$, where $K(x - y)$ is a nonlocal distribution and its Fourier transform $K(p^2)$ is an entire analytical function. The intermediate regularization procedure is introduced that the S-matrix is finite, unitary, causal, gauge invariant when regularization is moved off. The interaction Lagrangian maintains no infinite counter terms. (auth)

44104 MINIMALLY COUPLED SPIN-TWO FIELD. Tait, W. (Institut Henri Poincare, Paris). Phys. Rev., D; 5: No. 12, 3272-3(15 Jun 1972).

The minimally coupled spin-2 wave equation is examined and is shown to lead to the correct number of constraints. The difference between the equation used here and that considered by Velo and Zwanzier is made explicit. (auth)

44105 BROKEN SCALE INVARIANCE AND ASYMPTOTIC BEHAVIOR. Callan, Curtis G. Jr. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., D; 5: No. 12, 3202-10(15 Jun 1972).

It is shown that broken-scale-invariance Ward identities place strong restrictions on the asymptotic behavior of perturbation-theory amplitudes. (auth)

44106 HIGH-ENERGY SCATTERING IN ϕ^3 THEORY AND THE BREAKDOWN OF THE EIKONAL APPROXIMATION. I. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge. Deutsches Elektronen-Synchrotron, Hamburg); Wu, Tai Tsun. Phys. Rev., D; 5: No. 12, 3170-89(15 Jun 1972).

In order to test the general validity of the impact picture which was extracted from quantum electrodynamics at high energies, a systematic study is made of high-energy scattering amplitudes in ϕ^3 theory. The method used is the one developed in a previous treatment of quantum electrodynamics, and it enables the asymptotic amplitudes for multiple exchanges of Regge poles and scalar particles to be obtained in closed form. The results are nonperturbative and are valid to all orders of the coupling constant. It is shown in various examples that (i) the longitudinal momentum of the incident particle is always distributed in positive fractions by the particles created; (ii) an exchanged particle, either composite (Regge pole) or elementary, can carry only transverse momentum; (iii) the scattering amplitude satisfies the impact factor representation; (iv) except in the leading order of the coupling constant, the simple-exponentiation form of the eikonal approximation does not appear. The eikonal approximation fails in ϕ^3 theory because of particle creation: More than one particle may share the incident longitudinal momentum and it is impossible to single out a particular particle to be associated with the eikonal path. The above conclusions are reached by a study of the one-ladder amplitude and the amplitude for the double exchange of a ladder and a scalar particle. An integral equation for the Regge parameters of a ladder was derived and many properties of the Regge parameters were given. In particular, in the Wick-Cutkosky model, the Regge pole at zero invariant mass $\alpha(0) = 1$ when the coupling constant g is equal to $4\sqrt{6\pi}m$, where m is the mass of the scalar meson. Thus the physical picture of an expanding black disk in quantum electrodynamics is also realized in the Wick-Cutkosky model as long as $g > 4\sqrt{6\pi}m$. The scattering amplitude for the double exchange of a ladder and a scalar particle is given explicitly in terms of the Regge parameters of the ladder diagrams. Throughout the investigation of ϕ^3 theory at high energies, there is exact correspondence with the results in quantum electrodynamics at every step. This reaffirms the belief of the general validity of the impact picture. (auth)

44107 SPONTANEOUSLY BROKEN GAUGE SYMMETRIES. III. EQUIVALENCE. Lee, Benjamin W. (National Accelerator Lab., Batavia, Ill. State Univ. of New York, Stony Brook); Zinn-Justin, Jean. Phys. Rev., D; 5: No. 12, 3155-60(15 Jun 1972).

The equivalence of the S matrix in the R- and U-gauge formulations of spontaneously broken gauge theories is discussed. Definitions of the U-gauge Green's functions are given in terms of the R-gauge ones, for both Abelian and non-Abelian cases. Based on the equivalence theorem, a renormalization prescription of the U-gauge formulation is given. (auth)

44108 SPONTANEOUSLY BROKEN GAUGE SYMMETRIES. II. PERTURBATION THEORY AND RENORMALIZATION. Lee, Benjamin W. (National Accelerator Lab., Batavia, Ill. State Univ. of New York, Stony Brook); Zinn-Justin, Jean. Phys. Rev., D; 5: No. 12, 3137-55(15 Jun 1972).

The second paper in this series is devoted to the formulation of a renormalizable perturbation theory of Higgs phenomena (spontaneously broken gauge theories). In Sec. II, the renormalization prescription for massless Yang–Mills theories is reformulated in terms of gauge-invariant renormalization counterterms in the action. Section III gives a group-theoretic discussion of Higgs phenomena. The possibility that an asymmetric vacuum is stable is discussed, and it is shown how the symmetry of the physical vacuum determines the mass spectrum of the gauge bosons. It is shown further that in a special gauge (U gauge), all unphysical fields can be eliminated. Section IV discusses the quantization of a spontaneously broken gauge theory in the R gauge, where, as shown in Sec. V, Green's function are made finite by the renormalization counterterms of the symmetric theory (in which the gauge invariance is not spontaneously broken). The R-gauge formulation makes use of redundant fields for the sake of renormalizability. Section VI is a discussion of the low-energy limits of propagators in the R-gauge formulation. In Sec. VII it is shown that the particles associated with redundant fields peculiar to the R-gauge formulation are unphysical, i.e., they do not contribute to the sum over intermediate states. (auth)

44109 SPONTANEOUSLY BROKEN GAUGE SYMMETRIES. I. PRELIMINARIES. Lee, Benjamin W. (National Accelerator Lab., Batavia, Ill. State Univ. of New York, Stony Brook); Zinn-Justin, Jean. Phys. Rev., D; 5: No. 12, 3121-37(15 Jun 1972).

This is the first of a series of papers addressed to the renormalizability question of spontaneously broken gauge theories. A brief outline is given of the motivation for such an investigation and the manner in which the renormalizability of such theories will be proved in the sequel is described. Put briefly, it is shown that in an appropriate gauge, ultraviolet divergences of a spontaneously broken gauge theory are removed completely by the gauge-invariant counterterms in the Lagrangian which would make the Green's functions of the corresponding unbroken gauge theory finite, that the S matrix computed in this gauge is unitary, and that the S matrix is independent of the gauge chosen. The renormalizability question of the unbroken gauge theory is considered. The Ward–Takahashi identities of the theory are derived. Several ways of regulating divergent Feynman integrals of the theory without destroying gauge invariance are discussed. Infrared divergences are avoided by the device of intermediate renormalization, wherein some points where external momenta are Euclidean are chosen as subtraction points. This suffices to establish that the Bogoliubov–Parasiuk–Hepp renormalization will give renormalized Green's functions which satisfy the Ward–Takahashi identities. The existence of finite, renormalized Green's functions satisfying the Ward–Takahashi identities provides the means of proving the renormalizability of the spontaneously broken symmetry case. The Ward–Takahashi identities were previously derived for the gauge bosons by Slavnov. A new derivation is presented. The discussions on regularization methods and intermediate renormalization procedure and the renormalization conditions for matter fields are believed to be new contributions. (auth)

44110 SPACE–TIME CODE. III. Finkelstein, David (Yeshiva Univ., New York). Phys. Rev., D; 5: No. 12, 2922-31(15 Jun 1972).

The quantum (q) concept of space-time dynamics described previously is extended from free to interacting systems. The idea is developed that the world is not a plenum of q objects but a plexus of q processes. The q mode of description by Hilbert-space vectors with a special rule of interpretation (stators) ordinarily used for physical objects is used instead for physical processes acting upon objects, including free propagation. The geometrical object proposed as stator for a q network of processes is a natural generalization of a tensor, a Feynman-diagram amplitude, and a chain in a complex, called a plexor. The notation, algebra, and geometry of plexors is illustrated. A strong Mach principle is a self-evident feature of such a q-process theory of space-time, in which it is meaningless to speak of empty space-time or of space-time relations between noninteracting systems. (auth)

44111 FIELD THEORY FOR STABLE AND UNSTABLE PARTICLES. Hammer, C. L.; Weber, T. A. (Iowa State Univ., Ames). Phys. Rev., D; 5: No. 12, 3087-3102(15 Jun 1972).

A completely covariant field theory is developed which includes both stable and unstable particle fields. Exact single-particle propagators for both the unstable and stable cases are derived for arbitrary spin in terms of matrix elements of the basic interaction. The free-particle approximation to these propagators does not contain the unphysical terms which are usually present in the propagators derived in the interaction picture. The relationship to the Lehmann spectral representation is established and general equations for the various renormalization constants are given. Based upon general considerations it is shown that in the limit of high momentum transfer an extra factor t^{-2} occurs in the cross section for 2-particle-to-2-particle scattering, more in line with experimental observations. (auth)

44112 SHORT-DISTANCE BEHAVIOR OF QUANTUM ELECTRODYNAMICS AND AN EIGENVALUE CONDITION FOR alpha. **Adler, Stephen L. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., D; 5: No. 12, 3021-47(15 Jun 1972).**

A review and extension is given of earlier work dealing with the short-distance behavior of quantum electrodynamics. It is shown that if the renormalized photon propagator is asymptotically finite, then in the limit of zero fermion mass all of the single-fermion-loop 2n-point functions, regarded as functions of the coupling constant, must have a common infinite-order zero. In the usual class of asymptotically finite solutions introduced by Gell-Mann and Low, the asymptotic coupling α_0 is fixed to be this infinite-order zero and the physical coupling $\alpha < \alpha_0$ is a free parameter. It is shown that if the single-fermion-loop diagrams actually possess the required infinite-order zero, there is a unique, additional solution in which the physical coupling α is fixed to be the infinite-order zero. It is conjectured that this is the solution chosen by nature. According to this conjecture, the fine-structure constant is determined by the eigenvalue condition $F^{[1]}(\alpha) = 0$, where $F^{[1]}$ is a function related to the single-fermion-loop vacuum-polarization diagrams. The eigenvalue condition is independent of the number of fundamental fermion species which are assumed to be present. (auth)

44113 MULTIPOLE SINGULARITIES IN SPECIAL-RELATIVISTIC NONLINEAR FIELD THEORIES. **Havas, Peter (Temple Univ., Philadelphia). Phys. Rev., D; 5: No. 12, 3048-65(15 Jun 1972).**

The general form of the equations of motion of a particle possessing multipole singularities of a classical neutral meson field of spin zero or one was found by Harish-Chandra, and for a more general form of the interaction as well as for charged and charge-symmetric fields by Havas. In two recent papers, forms of the multipole moments of arbitrary order of such fields (including the electromagnetic field as a special case) were found; they were established under the assumption that the spin of the particle is of constant magnitude and orthogonal to the four-velocity, for constant magnitude ("intrinsic moments") or variable magnitude ("induced moments," acceleration-dependent forces) of such moments. The case of charged and charge-symmetric meson fields interacting with electromagnetic fields is studied, for which the field equations are nonlinear, and the theory admits gauge invariance of the first and second kind. The laws of motion are found by a method developed earlier on the basis of work by Mathisson. It is then shown that these laws are compatible with the same forms of the intrinsic and induced electromagnetic and mesonic multipole moments as found for noninteracting fields, provided a simple equation for the variation of the classical "isotopic spin" is adopted, which is a generalization of the equation postulated in the noninteracting case and which is compatible with the equation of conservation of charge. In spite of the nonlinearity of the field equations, the particle can carry an arbitrary linear combination of such multipole moments. The methods used appear to be applicable to other nonlinear field theories. (auth)

44114 SPONTANEOUS VIOLATION OF DILATATION INVARIANCE IN RELATIVISTIC FIELD THEORIES. **Aurilia, A. (Univ. of Alberta, Edmonton); Takahashi, Y.; Papastamatiou, N. J.; Umezawa, H. Phys. Rev., D; 5: No. 12, 3066-77 (15 Jun 1972).**

Adopting the point of view that the mass of observed particles is dynamical in origin, the effect of spontaneous breakdown of dilatation invariance is investigated. Neither extra fields nor anomalous dimensions are introduced from the outset so that the Lagrangians in our formalism are strictly invariant against dilatation transformation. The Bethe–Salpeter equation is employed throughout in order to demonstrate that, in the pair approximation, the appearance of massive fields does not contradict the formal invariance of the theory. The result is interpreted in terms of the dimensional transformation previously introduced by the authors. It is shown that the dilatation transformation for the Heisenberg operators turns into the dimensional transformation for the massive asymptotic fields and the inhomogeneous dilatation transformation for the Goldstone boson, and that the very appearance of the inhomogeneous term cancels the extra dimension brought in by the mass. A Goldberger–Treiman-like relation is derived. Finally, it is pointed out that the composite nature of the Goldstone boson in one model seems to be the distinctive feature leading to a nontrivial scattering matrix. (auth)

44115 RADIATIVE CORRECTIONS AND THE MASS OF THE YANG–MILLS FIELD. **Russo, M. J. (Aerospace Research Labs., Wright-Patterson AFB, Ohio. Northeastern Univ., Boston); Fickler, S. I. Phys. Rev., D; 5: No. 12, 2966-77(15 Jun 1972).**

It is shown that if one assumes the existence of massless single-particle states for the Yang–Mills field, a consistent Lorentz-covariant theory good to second order in the coupling constant results. That is, the vacuum polarization resulting from the self-coupling of the Yang–Mills field gives rise only to a renormalization of the coupling constant g_0. This is shown by calculating the Yang–Mills Green's function to order $(g_0)^2$ in the radiation gauge. The zero-mass "fictitious" scalar mesons of Feynman and DeWitt are seen to arise naturally in the radiation-gauge formalism. It is further shown that they are necessary to guarantee that the mass renormalization δm^2 is zero for this non-Abelian gauge theory (just as it is in the Abelian gauge theory of electrodynamics). (auth)

44116 RENORMALIZATION GROUP AND HIGH-ENERGY QUANTUM ELECTRODYNAMICS. **Perrin, Robert (Brandeis Univ., Waltham, Mass.). Phys. Rev., D; 5: No. 12, 2955-8 (15 Jun 1972).**

The renormalization group is used to derive a series expansion of the high-energy Green's functions in the Johnson–Willey–Baker model of electrodynamics. (auth)

44117 WARD IDENTITIES FOR THE ENERGY–MOMENTUM TENSOR. **Banks, Thomas (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 5: No. 12, 2959-65(15 Jun 1972).**

Using model-independent arguments, several Ward identities are derived for the correlation function of the energy-momentum tensor with an arbitrary current. (auth)

44118 FINITE DIFFERENCE SCHROEDINGER EQUATION. **Meessen, A. (Univ. Catholic, Louvain, Belg.). Ann. Soc. Sci. Brux. Ser. I; 86: No. 1, 89-100(1972).**

To avoid any arbitrariness, one should consider the ultimate limit for the smallest measurable distance as an unknown quantity whose value could be finite as well as zero. This implies that the usual differential equations of quantum mechanics should be considered as limiting cases of some adequate finite difference equations. The "correspondence principle" which allows one to set up these finite difference equations is justified by checking the internal consistency of the theory, in the case where the light velocity $c = \infty$. (auth)

44119 PERTURBATION EXPANSIONS IN AXIOMATIC FIELD THEORY. **Steinmann, Othmar. Lecture Notes in Physics. Volume 11. New York; Springer-Verlag, New York, Inc. (1971). 130p. $5.00.**

The lectures cover the LSZ formalism, the basic formalism of perturbation theory, the equation $r_\sigma(x,y,X) - r_\sigma(y,x,X) = I_\sigma(x,y,X)$, small distance behavior, the properties of I_σ, existence, and renormalizable theories. (J.F.P.)

44120 ANALYTICAL MECHANICS FOR RELATIVISTIC FLUIDS. **Gilain, Christian (Univ., Paris). Compt. Rend., Ser. A; 274: No. 11, 929-32(13 Mar 1972). (In French).**

Equations are established for the dynamics of relativistic fluids using Lagrangians in a Banach variety. Very general equations are obtained using the sum of a kinetic and a potential term as the Lagrangian. It is also possible to establish the equations generally accepted for the dynamics of perfect isentropic fluids with a purely kinetic Lagrangian by incorporating the index of the fluid. (France)

44121 REGULARIZATION AND RENORMALIZATION OF GAUGE FIELDS. **'t Hooft, G.; Veltman, M. (Univ., Utrecht). Nucl. Phys.; B44: No. 1, 189-213(1972).**

A new regularization and renormalization procedure is presented. It is particularly well suited for the treatment of gauge theories. The method works for theories that were known to be renormalizable as well as for Yang–Mills type theories. Overlapping divergencies are disentangled. The procedure respects unitarity, causality and allows shifts of integration variables. In non-anomalous cases also Ward identities are satisfied at all stages. It is transparent when anomalies, such as the Bell–Jackiw–Adler anomaly, may occur. (auth)

44122 GREEN'S FUNCTIONS FOR THE MASSIVE YANG–MILLS FIELD. **Nishjima, Kazuhiki; Watanabe, Tadashi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1378-84(Apr 1972).**

The Dyson formula applicable to the massive Yang–Mills field is derived by using a technique previously proposed in connection with chiral type non-linear field theories. It is concluded that the conventional Dyson formula without any modification is valid in this case. (auth)

44123 SEARCH FOR THE ANOMALY-FREE INTERACTIONS. **Kikugawa, Hiroyuki (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1396-9(Apr 1972).**

By the use of the Pauli–Villars regularization method, it is proved that an anomaly-free theory can be constructed in both

Abelian and non-Abelian cases, provided that the interactions always appear in an appropriate combination of the interactions with properly chosen coupling constants. (auth)

44124 REGULARIZATION OF QUANTUM ELECTRODYNAMICS THROUGH NON-POLYNOMIAL LAGRANGIANS. Budini, P. (International Centre for Theoretical Physics, Trieste, Italy); Calucci, G. Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 173-91(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

A model for regularizing quantum electrodynamics through a non-polynominal Lagrangian describing the interaction of the electron field with an auxiliary fields is given. A gauge invariant Lagrangian density is obtained. This kind of regularization avoids the difficulties connected with indefinite metric. Renormalization of quantum electrodynamics is performed for irreducible diagrams. In the hypothesis that this kind of regularization is the physical basis for the elimination of divergences in quantum electrodynamics, the physical implications are discussed. In particular, the limits of validity of quantum electrodynamics are discussed in terms of the coupling constant between the electron and the regularizing field. It is found that the present limits of validity of quantum electrodynamics imply for this coupling constant an upper limit larger than the weak coupling constant. The possibility of regularization through weak interactions is discussed. In this model, for every reasonable coupling constant, the electromagnetic self-mass of the electron is only a fraction of the total mass. (auth)

44125 CALCULATION OF COMPLEX-CONJUGATE PAIRS OF REGGE TRAJECTORIES WITH THE SCALAR BETHE–SALPETER EQUATION. Ladanyi, K. (Research Group for Theoretical Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 265-71(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

The Bethe–Salpeter equation of scalar particles is reduced to a form which is tractable numerically. This formalism is applied to the numerical calculation of Regge trajectories. Particular attention is paid to the level mixing effects of the mass difference leading to complex-conjugate pairs of trajectories. The calculations include the imaginary part of the total energy at real values of the angular momenta. (auth)

Gravitation and General Relativity

44126 HYDRODYNAMICAL ANALOGY FOR SOME EFFECTS OF THE GENERAL RELATIVITY THEORY. Vovchenko, A. P. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 12, 2036-42(Dec 1971). (In Russian).

The paper is based on the results obtained in (Vovchenko, A.P. Upr. Fiz Zh, 16, No. 2, (1971)). While analyzing the movement of S. A. Chaplygin's gas, local time depending on gravitation and 4-dimensional measurements corresponding to it are introduced. The hydrodynamical analogy for some astrophysical effects of the general relativity theory is shown. (auth)

44127 GRAVITY AND SCALING. Manoukian, Edward B. (Univ of Alberta, Edmonton). Phys. Rev., D; 5: No. 12, 2915-22(15 Jun 1972).

Starting from Schwinger's source theory, a theory of gravitation is constructed. It is of the type of Sen's. Unlike his, however, no vector field is introduced and the so-called "auto-parallels" and "geodesics" are identical in our formulation. The concept of general reference-system transformation of Lyra follows quite naturally from our work and a conservation law of the energy-momentum tensor of matter is obtained. Invariant actions under general reference-system transformations for both scalar and spinor (spin-$\frac{1}{2}$) Lyra fields are constructed. The transformation of Lyra and Einsteinian quadratic forms under a general reference system is considered and gauge-dependent fields are introduced to discuss the meaning of scaling and scale invariance. The theory (the actions) is manifestly scale-invariant and brings a very close and a natural connection between gravitation in the manner of Lyra, scaling, and scale invariance. It is the "switching off" of the gravitational coupling constant that loses the meaning of such an invariance. (auth)

44128 SL(2,C) INVARIANCE AND THE GRAVITATIONAL FIELD. Carmeli, Moshe (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Ann. Phys. (N. Y.); 71: No. 2, 603-10 (Jun 1972).

The gravitational field equations of general relativity theory are cast into a Yang–Mills type of theory by use of the group SL(2,C). The spin coefficients take the role of the Yang–Mills-like potentials, whereas the Riemann tensor takes the role of the fields. Comparison of this formalism with that of Utiyama and Kibble who related invariance under the Lorentz and the Poincaré groups to the existence of the gravitational field, is discussed. (auth)

44129 PROPAGATORS FOR ARBITRARY SPIN IN AN EINSTEIN UNIVERSE. Dowker, J. S. (Univ. of Manchester, Eng.). Ann. Phys. (N. Y.); 71: No. 2, 577-602(Jun 1972).

The evolution properties of arbitrary-spin classical fields in an Einstein universe are determined, at least in principle. A second-order propagation equation is used for both massless and massive fields but is shown to be misleading for the former, essentially because it is not conformally invariant. The massive case presents the unexpected feature of a "tachyonic mass gap." For example, for integral spin, j, if the mass lies between zero and a^{-1} j (a is the radius of the spatial section of the universe) the propagator develops imaginary mass poles due to the coupling of the spin and the metric. This gives rise to exponentially diverging propagation functions in the classical case and, possibly, to causality violations in the quantized theory. The calculation involves a generalization of Schwinger's spherical harmonics with operator arguments and a continuation of Racah coefficients off the angular-momentum shell. (auth)

44130 STABILITY OF THE SOLUTIONS OF NONLINEAR HYPERBOLIC EQUATIONS. APPLICATION TO MINKOVSKI SPACE–TIME IN GENERAL RELATIVITY THEORY. Choquet-Bruhat, Yvonne (Univ., Paris). Compt. Rend., Ser. A; 274: No. 10, 843-5(6 Mar 1972). (In French).

A theorem was established for the solutions of hyperbolic equations and was applied to the stability of Minkoyski space-time. (France)

44131 RELATIVISTIC HYDRODYNAMICS AND GRAVITATIONAL INSTABILITY. Jackson, J. C. (Univ. of Sussex, Brighton, Eng. Royal Greenwich Observatory, Herstmonceux, Eng.). Proc. Roy. Soc. (London), Ser. A; 328: No. 1575, 561-5(27 Jun 1972).

An exact geometrical identity is used to derive an equation which is interpreted as that governing the propagation of finite amplitude sound in general relativity. It is used to obtain a relativistic version of Jeans's instability criterion. (auth)

44132 PERIHELION MOTION OF PLANETS AND THE NEW THEORY OF GRAVITATION. Kar, K. C.; Bhattacharyya, A. K. (Inst. of Theoretical Physics, Calcutta). Indian J. Theor. Phys.; 20: No. 1, 1-8(Mar 1972).

Einstein's formula for the advance of perihelion of planets was deduced following his simple theory of relativity, without taking any help of the complicated so called generalized theory of relativity. In the new theory of gravitation (Ind. Jour. Theo. Phys. Vol. 19, p. 1, 1971) it was shown that the gravitational force is always attractive and that the law of attraction is same as in classical mechanics. On using this law and introducing relativistic correction in the law of area, Einstein's formula for perihelion advance was deduced in a very simple manner. It is thus shown that Einstein's general theory is not necessary for solving this problem. (auth)

44133 NEW BOUNDARY CONDITION IN GENERAL RELATIVITY. Kofinti, N. K. (Univ. of Ghana, Legon). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1410-17(Apr 1972).

It is shown that both the Schwarzschild problem of determining the interior and exterior fields of a homogeneous statical sphere consisting of a perfect fluid as well as Bonnor's approach to the problem of the stability of cosmological models are consistent with a new boundary condition recently derived by Nariai. (auth)

Scattering Theory

Refer also to abstract 44341.

44134 VENEZIANO MODEL AND CURRENT ALGEBRA. Collins, P. V. (Cambridge Univ., Eng.). Nucl. Phys.; B43: 289-300(15 Jun 1972).

General current amplitudes which are consistent with planar duality, factorization and current conservation are considered. The spurious states are allowed to contribute in order to avoid a trivial current algebra. It is then found that the amplitudes satisfy the charge algebra, and that they and their divergences have the correct pole structure for consistency with local current algebra. The asymptotic behavior of the amplitudes is not determined. (auth)

44135 RELATION BETWEEN THE COUPLING CONSTANT AND THREE-PARTICLE PRODUCTION IN S-MATRIX THEORY.

Beers, B. L. (Southern Illinois Univ., Carbondale). Nucl. Phys.; B43: 457-69(15 Jun 1972).

Three particle production in the high angular momentum limit is related to the residue at the pole of the elastic amplitude. If there is no three particle production there can be no pole. Unitarity forces the coupling constant to be real. The results depend only on unitarity, crossing, and Mandelstam analyticity. (auth)

44136 NEW OFF-SHELL DUAL N-POINT AMPLITUDE. Dorren, J. D. (Cambridge Univ., Eng.). Nucl. Phys.; B43: 634-40(15 Jun 1972).

An SU(1,1) invariant amplitude for N off-mass-shell scalar particles is constructed. It reduces to the Koba—Nielsen form of the dual N-point amplitude with arbitrary intercept when all external particles are put on-mass-shell. The propagator of the off-shell particles has a satisfactory structure for intercepts other than zero or an integer. (auth)

44137 S-MATRIX THEORY OF ELEMENTARY PARTICLES. Regge, T. (Inst. of Advanced Study, Princeton, N. J. Univ., Turin). pp 395-402 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

A set of recommendations and a list of technical problems to be solved as a preliminary step toward the construction of a theory of the S-matrix are presented. (J.F.P.)

44138 IMPACT-PARAMETER DESCRIPTION AND THE s–u SYMMETRY CONSTRAINT. Itabashi, K. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 4: No. 7, 241-5(17 Jun 1972).

Models of scattering amplitudes which try to incorporate the notion of duality into the direct-channel geometrical description, based on the impact-parameter representation, are considered for the nondiffraction part of the amplitude. A prescription is proposed which guarantees the compatibility of the geometrical description with the s-u crossing symmetry constraints. (L.B.S.)

44139 RELATIONSHIP BETWEEN THE GLAUBER APPROXIMATION AND THE WATSON MULTIPLE-SCATTERING THEORY. Eisenberg, J. M. (Univ. of Virginia, Charlottesville). Ann. Phys. (N. Y.); 71: No. 2, 542-55(Jun 1972).

The relation between Watson's multiple-scattering theory and Glauber's approximate multiple-scattering theory for high energies is explored, and a direct derivation of the latter from the former is presented in the context of potential scattering. The cancellations between all off-shell contributions to the first A terms of the Watson series for the transition matrix (for a system of A scatterers) and the remainder of the infinite series are explicitly exhibited in the high-energy limit. This cancellation is complete for $A = 2$, but is only partial when $A \geq 3$ in which situation on-shell components of the first A terms also enter into canceling the remainder of the series. A comparison is given between these results and those of previous efforts to derive Glauber's approximation from the Watson theory. (auth)

44140 SCHWINGER VARIATIONAL PRINCIPLE AND PADE APPROXIMANTS. Garibotti, C. R. (Univ., Bari, Italy). Ann. Phys. (N. Y.); 71: No. 2, 486-96(Jun 1972).

It is shown that any [N, M] Padé approximant to the nonrelativistic scattering amplitude is equivalent to solving the scattering equations in a particular finite subspace. It follows that the Padé approximants can be obtained by using appropriate trial functions in the Schwinger variational principle. The possible application of the stationary principle to determine an optimal subspace is discussed. (auth)

44141 REGGE POLES FOR LARGE COUPLING CONSTANTS. I. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge. Deutsches Elektronen-Synchrotron, Hamburg); Wu, Tai Tsun. Phys. Rev., D; 5: No. 12, 3189-91(15 Jun 1972).

The problem of scattering by an attractive Yukawa potential is studied. In particular, the positions of Regge poles are found approximately when the coupling constant is large. (auth)

44142 REGGE POLES FOR LARGE COUPLING CONSTANTS. II. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Phys. Rev., D; 5: No. 12, 3192-3201(15 Jun 1972).

Since the Pomeranchon is defined to be the leading singularity of the "potential," and it is found that a high-energy particle resembles an expanding black disk if this singularity is located at $J > 1$, the generation of such a singularity by the ladder diagrams is studied as a model in ϕ^3 theory. It is found that, when the coupling constant is sufficiently large, there are Regge poles located at $J > 1$. Thus the Pomeranchon in this model is a Regge pole with $\alpha(0) > 1$. This conclusion is reached by solving the Bethe—Salpeter equation to determine, in the strong coupling limit, the positions of the Regge (or Toller) poles at $t = 0$. A family of approximately equally spaced Toller poles is found. The position of the leading singularity, but not the spacing, depends critically on whether the exchanged particle is massless or massive. Some numerical results are presented. (auth)

44143 UNITARY MODELS OF MULTIPARTICLE AMPLITUDES. Aviv, R. (Univ. of California, Santa Barbara); Sugar, R. L.; Blankenbecler, R. Phys. Rev., D; 5: No. 12, 3252-62(15 Jun 1972).

A class of models of multiparticle scattering and production amplitudes is constructed for which the S matrix is exactly unitary at high energies. Two specific models are studied in detail. One leads to a constant total cross section, the other to a logarithmically increasing one. Particle production in inclusive and exclusive experiments is considered for both models. (auth)

44144 COMPARISON OF PLANE-WAVE APPROXIMATIONS IN POTENTIAL SCATTERING. Ebden, J. R.; Darewych, J. W. (York Univ., Downsview, Ont.). Can. J. Phys.; 50: No. 10, 1030-9(15 May 1972).

Four different plane-wave approximations for scattering by short-range potentials are compared. These four are the first and second Born approximations, the plane-wave Schwinger approximation and a restricted form of Ford's renormalized Born approximation. For the Yukawa and Gaussian potentials, the differential and total cross sections are calculated in the energy range $0.01 \leq k^2 \leq 10$ (arbitrary units) and for dimensionless coupling constants ranging between 0.1 and 10. The first Born and renormalized Born are "first-order" approximations, requiring an order of magnitude less calculational labor than the second Born and Schwinger approximations. The results suggest that the restricted renormalized Born approximation is rarely better than the ordinary first Born approximation. The Schwinger plane-wave approximation is always better than the second Born approximation and since these involve the evaluation of identical expressions, the Schwinger approximation is always to be preferred over the second Born. The Schwinger plane-wave approximation gives quite consistently the best results of the four methods considered, but even it is not to be trusted for calculating differential cross sections at large angles or for reproducing "resonance structure" in total cross sections. (auth) (Canada)

44145 EIKONAL APPROXIMATION IN THE FUNCTIONAL INTEGRATION METHOD. Adachi, Toshimi (Tokyo Metropolitan Tech. Coll.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1432-4 (Apr 1972).

It is shown that an expression for the complete scattering amplitude is obtained by the functional integration method applied to Green's function for the potential scattering, and that the expression for the scattering amplitude reduces naturally to the usual form of the eikonal approximation. (L.B.S.)

44146 NOYES–KOWALSKI APPROXIMATION FOR THE OFF-SHELL T-MATRIX AND A SEPARABLE POTENTIAL. Shimauchi, Masaaki (Saga Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1443-4(Apr 1972).

It is shown that the Noyes—Kowalski approximation for the off-shell T-matrix is exactly equivalent to approximating the potential by a separable potential of rank one. (L.B.S.)

44147 REAL PART OF RESONANCE CORRELATION. Imachi, Masahiro (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1445-7(Apr 1972).

It has been argued that the real part of the s-channel resonant amplitude cannot be known from information on s-channel resonances in the meaning of local or semi-local duality since they will lead to a null result by a cancellation in the integranel. It is shown that a non-null result is obtained when the resonance correlation is correctly taken into account. (L.B.S.)

44148 CHARGED-PARTICLE DISTRIBUTION FUNCTION IN A CONDENSED MEDIUM WITH AN AXIALLY SYMMETRIC MAGNETIC FIELD. Kimel, L. R.; Salimov, O. N. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 12, 2089-91(Jun 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 12, 2628-31(Dec 1971).

The Fermi equation for the charged-particle distribution function in a scattering medium was generalized to the case in which the medium is in an axially symmetric magnetic field given by $B = qr$, where r is the radial distance from the beam axis and q is a proportionality constant. The appropriate equation is solved analytically. Under certain assumptions, the medium has focusing properties and can be used to transport particles while simultaneously reducing their energy. Numerical calculations were made for muons with a momentum of 30 GeV/c moving in iron. The applicability limits of the results are discussed. (auth)

44149 LOCAL REPRESENTATIONS FOR FORWARD SCATTERING. Niedermayer, F. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 31: No. 1-3, 273-6(1972).

From second symposium on hadron spectroscopy; Balatonfuered, Hungary (6 Sep 1970). See CONF-700937.

It is shown that the Jost—Lehmann representation may be written in a more simple form in the case of forward scattering, which is similar to the Deser—Gilbert—Sudarshan representation. The existence condition for the DGS representation is analyzed and some features of this representation are shown. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

44150 INVESTIGATION OF ^{3}He DIFFUSION IN LIQUID ^{4}He BY MEANS OF THERMAL NEUTRONS. Drabkin, G. M.; Noskin, V. A.; Trunov, V. A.; Shchebetov, A. F.; Yagud, A. Z. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 142-3(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 180-2(Jan 1972).

A new method has been developed for investigating the diffusion of ^{3}He in liquid ^{4}He. The temperature dependence of the diffusion coefficient in weak ^{3}He–^{4}He solutions is investigated in the temperature range from 3°K to T_λ. (auth)

44151 GROWING COLLECTIVE MODES IN VORTEX RING BEAMS IN He II. Gamota, George (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett.; 28: No. 26, 1691-3(26 Jun 1972).

Growing collective modes are observed in beams of charged vortex rings in superfluid helium. The growth of the waves is found to be dependent upon the path length of the beam and the modulation frequency, in agreement with theory. (auth)

44152 COLLECTIVE MODES IN STREAMS OF CHARGED VORTEX RINGS. Hasegawa, Akira; Varma, C. M. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett.; 28: No. 26, 1689-91(26 Jun 1972).

It is shown that a stream of charged vortex rings supports collective modes that are unstable below a critical wave number, thus leading to a charge-density wave structure. The negative effective mass of a gas of vortex rings plays a crucial role in the instability. For a singly charged stream, the situation is analogous to that of gravitational collapse. (auth)

44153 POSITIVE IMPURITY IONS IN He II. Johnson, Warren W.; Glaberson, William I. (Rutgers—The State Univ., New Brunswick, N. J.). Phys. Rev. Lett.; 29: No. 4, 214-17(24 Jul 1972).

A technique was developed for introducing a variety of impurity atomic ions into liquid helium and measuring their mobility. It was found that, in contrast with predictions of the "snowball" model of Atkins, the ion mobility depends on the atomic number of the core ion in a way that cannot be explained simply in terms of the mass of the ion. The relative mobility of ^{40}Ca and ^{48}Ca ions was measured and is consistent with existing theories. (auth)

44154 QUARTZ MICROBALANCE STUDIES OF AN ADSORBED HELIUM FILM. Chester, Marvin (Univ. of California, Los Angeles); Yang, L. C.; Stephens, J. B. Phys. Rev. Lett.; 29: No. 4, 211-14(24 Jul 1972).

The resonant frequency of a quartz crystal oscillating in the thickness-shear mode changes by virtue of the mass loading due to any type of film laid down on its surfaces. For a helium film only the normal fraction remains rigidly coupled to the substrate motion. Adsorption isotherms of ^{4}He measured with this technique show clear departures from conventional nonsuperfluid behavior. This effect is attributed to the onset and presence of superfluidity in the film. (auth)

44155 TORQUE ON A RAYLEIGH DISK DUE TO He II FLOW. Trela, Walter J. (Haverford Coll., Pa.). Phys. Rev. Lett.; 29: No. 1, 38-41(3 Jul 1972).

A model for He-II flow past a Rayleigh disk is presented which assumes that superfluid potential flow and normal fluid Helmholtz flow occur. A torque which increases as the temperature decreases is predicted, agreeing with Pellam's measurements in rotating helium below T_λ. New measurements of the torque on a Rayleigh disk in nonrotating helium are presented, indicating Helmholtz flow above T_λ, a continuous torque at the λ point, and increasing torque below T_λ. (auth)

44156 SPIN DIFFUSION COEFFICIENT OF DILUTE SOLUTIONS OF LIQUID ^{3}He IN ^{4}He UNDER PRESSURE. Cheng, Dunson Ka-fat. Stony Brook, N. Y.; State Univ. of New York (1972). 143p. University Microfilms Order No. 72-16,968. Thesis.

The spin-diffusion coefficient of ^{3}He atoms in ^{4}He solutions at molar concentrations of 1.15% and 4.97% is measured between the temperature range of 1.5°K and 0.072°K, at pressures of 0.04, 9.2, and 20.0 atmospheres. A dilution refrigerator is employed to obtain low temperatures. Pressures are generated by compression of bellows. The spin-echo technique is used to measure the diffusion coefficient with a 90-90-180 pulse sequence. It is found that the diffusion coefficient decreases with increasing pressures for the entire temperature range investigated and for both concentrations. The experimental results are analyzed in terms of the phase shifts calculated from an effective potential acting between two ^{3}He atoms. The potential is assumed to be a square well with a hard core. The phase shifts at different pressures are found to lie within 10% of each other. However, the variation of the depth and the range of the potential as a function of pressures is large, and the present data support the suggestion that a repulsive tail exists in addition to the square well. With the present phase shifts, thermal conductivity, viscosity lifetime, and the transition temperatures of the ^{3}He subsystem into superfluid are calculated. It is found that the highest transition temperature occurs at 10^{-8}°K for a ^{3}He concentration of 1.24% and at the saturated vapor pressure of the solution. (Diss. Abstr. Int., B)

44157 CRITICAL LOOK AT A CLASS OF CRITICAL VELOCITY THEORIES FOR SUPERFLUID He. Campbell, L. J. (Los Alamos Scientific Lab., N. Mex.). J. Low Temp. Phys.; 8: No. 1-2, 105-13(Jul 1972).

Elementary considerations show that under steady-state flow conditions the energy required to create vortices cannot come from the stream, contrary to all previous theories of vortex creation and growth except the fluctuation model. (auth)

44158 INFLUENCE OF A dc HEAT FLUX ON THE VELOCITY OF SECOND SOUND NEAR T_λ. Bhagat, S. M.; Davis, R. S. (Univ. of Maryland, College Park). J. Low Temp. Phys.; 7: No. 1-2, 157-67(Apr 1972).

The speed of second sound, u_2 in He II, was measured in the presence of a heat flux Q. For $T_\lambda - 1\ \text{mK} > T > T_\lambda - 3.5\ \text{mK}$, it is found that u_2 reduces linearly with Q^2, for $2\ \text{mW/cm}^2 < Q < 6\ \text{mW/cm}^2$. By extrapolating the data it was deduced that the lambda transition temperature reduces linearly with Q. (auth)

Superconductivity

Refer also to abstracts 44518, 44563, and 44573.

44159 (BNL–16615) THERMAL CONDUCTIVITY OF BRAIDED SUPERCONDUCTOR SYSTEMS. DeVito, B.; Jensen, J. E. (Brookhaven National Lab., Upton, N. Y.). 1972. 17p. (CONF-720803–1). Dep. NTIS.

From Cryogenic engineering conference; Boulder, CO. (8 Aug 1972).

Heat transfer within a superconducting matrix as in magnet coils is of importance to magnet designers. A series of experiments designed to give engineering values of the thermal conductivity within two heterogeneous braided superconductor systems is described. The systems tested and the experimental procedure are described. The results are presented along with a comparison to a mathematical model. (auth)

44160 (ORNL-TM–3887) EXPERIMENTS ON STABILITY OF Nb_3Sn RIBBONS. Efferson, K. R.; Long, H. M. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 8p. (CONF-720513–10). Dep. NTIS.

From Applied superconductivity meeting; Annapolis, MD. (1 May 1972).

A series of magnetization experiments were performed in an attempt to simulate conditions in previously performed cusp coil tests. A comparison of the cusp coils and magnetization tests is presented. Also, the latest use of these results in building a 3-in. clear-bore, 115-kG laboratory magnet from Nb_3Sn ribbon is described. (M.H.R.)

44161 DEPRESSION OF THE TRANSITION TEMPERATURE OF THIN SUPERCONDUCTING FILMS BY NOBLE-GAS OVERLAYERS. Naugle, D. G.; Baker, J. W. (Texas A and M Univ., College Station). Phys. Lett.; 40A: No. 2, 145-7(3 Jul 1972).

When care is taken to prevent contamination, the superconducting transition temperatures in Al and Sn films are depressed by overlayers of Ne or Ar. The experimental results can be explained by the modification of the surface phonon spectrum. (auth)

44162 ATTENUATION OF MICROWAVE ULTRASONICS IN THIN-FILM SUPERCONDUCTING Pb. Akao, F. (Osaka Univ.). Phys. Lett.; 40A: No. 2, 159-60(3 Jul 1972).

The ultrasonic attenuation of superconducting Pb film in the magnetic field was measured at frequency 9.4 GHz. The field dependence of the attenuation coefficient of the thin film Pb was compared to theoretical expression. (auth)

44163 DESTRUCTION OF SUPERCONDUCTIVITY IN LEAD BY CURRENT. Sulkowski, C.; Szymaszek, J.; Makiej, B.;

Cizek, M. (Inst. for Low Temperature ard Structure Research, Wroclaw). Acta Phys. Pol.; A41: No. 6, 779-81(Jun 1972).

Results of measurements of the destruction of superconductivity of high-purity lead (with the resistance ratio $R_{300K}/R_{4.2K} = 5300$) are reported. The value of the resistance jump obtained from the measured transition curves amounts to 0.71 ± 0.03 of that observed in normal conditions. (auth)

44164 COMPOUNDS AND PSEUDO-BINARY ALLOYS WITH THE $CuAl_2$(C16)-TYPE STRUCTURE. IV. SUPERCONDUCTIVITY. Havinga, E. E.; Damsma, H.; Kanis, J. M. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 27: No. 3, 281-91(Jun 1972).

The superconductive transition temperatures, T_c, of all 46 binary compounds having the $CuAl_2$-type structure were measured, giving 25 superconductors above 0.07 K. Measurements were also made of T_c, as well as of the room-temperature values of the magnetic susceptibility χ and the thermoelectric power S in 16 pseudo-binary alloy systems having the C16-type structure and containing partly transition metals, and partly non-transition metals as major constituents. Plotted against the valence electron concentration, T_c, χ and S all show an oscillatory behavior. The results can be explained with the aid of Brillouin zone effects. (auth)

44165 MAGNETIC INSTABILITIES IN SHORT Nb–Ti SAMPLES. Hlasnik, I.; Rappanello, D. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Phys. Appl.; 6: No. 4, 445-52(Dec 1971). (In French).

From experiments on short samples (Nb–Ti) with transport current, the determinant influence of magnetic instabilities on the nominal characteristics of the superconducting materials was shown. The mathematical analysis of these experiments agrees with the theoretical adiabatic used model: from a simple geometrical shape, a stability criterion is determined which is verified by tests done on material stabilized with Pb and Au. A first approach of the training phenomenon is given in connection with diamagnetic currents in the superconducting material. (France)

44166 FLOW STRESS OF NORMAL AND SUPERCONDUCTING INDIUM. Hutchison, T. S.; McBride, S. L. (Royal Military Coll. of Canada, Kingston, Ont.). Can. J. Phys.; 50: No. 9, 906-11(1 May 1972).

Measurements of the flow stress of normal and superconducting indium are presented. These are explained by a model which involves only the difference in thermal activation of the mobile dislocations in the two states and yields a flow stress difference which, for pure materials, can be expressed in terms of the thermal conductivity as $(\sigma_N - \sigma_S) \sim \ln (K_N/K_S)$. This relation is compared with experiment for pure indium and lead. The flow stress is also shown to provide a sensitive method of observing flux trapping in pure superconductors. (auth) (Canada)

44167 COMMENTS ON LUTTINGER'S NEW MECHANISM FOR SUPERCONDUCTIVITY. Watanabe, Hirotoshi; Nojima, Koichiro (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1426-7(Apr 1972).

The possibility of superconductivity by a new mechanism was investigated by W. Kohn and J. M. Luttinger (Phys. Rev. Lett., 15: 524(1965)). Considering the second-order diagrams, they pointed out that there is a mechanism that effectively provides attractive interactions between particles even in the case of purely repulsive interactions. In order to analyze the problem they considered two-particle Green's functions and estimated the irreducible vertex part. In this note it is shown that their mechanism can be explained by deformation of the Fermi distribution and relation of the instability against the BCS state. The region of attractive interaction is also estimated. (M.H.R.)

44168 LOW-FIELD ENTROPY OF VORTICES IN SUPERCONDUCTORS. De Lange, O. L.; Otter, F. A. Jr. (Clarkson Coll. of Tech., Potsdam, N. Y.). J. Phys., Chem. Solids; 33: No. 8, 1571-81(Aug 1972).

The entropy of a stationary vortex (S_i) and of a moving vortex (S_d) is calculated in the low-field limit. S_d consists of a core contribution, S_c, and a thermal gradient contribution S_∇. The latter is present if, as suggested by Clem (1968), a moving vortex is not in thermal equilibrium. Comparison with experiment shows that the result $S_d > S_i$ for $T/T_c \leq 0.63$ in dirty type-II superconductors is reasonably well accounted for by $S_d = S_c + S_\nabla$. For a type-I superconductor and for Nb the gradient term appears to be absent, and the experimental results are satisfactorily described by S_c. The field dependence of the energy gap, at low fields, is estimated from the measured field dependence of S_d and S_i for $Nb_{85}Mo_{15}$. The values obtained from S_d and S_i are the same to within experimental error. (auth)

44169 METHOD OF EILENBERGER FOR INHOMOGENEOUS SUPERCONDUCTORS. Leung, M. C.; Jacobs, A. E. (Univ. of Toronto). Z. Phys.; 253: No. 2, 89-99(1972).

The theory of Eilenberger (Z. Phys., 214: 195(1968)) modified to take into account the effect of the surface, is applied to the problem of the penetration of a weak magnetic field into a semi-infinite superconductor, and the standard result for the vector potential is derived by linearizing the Eilenberger equations. The dominant term in the asymptotic behavior is argued to be monotonic for both large and small values of the Ginzburg–Landau parameter κ_{GL}. For $T \neq 0$, there is a small intermediate range of values of κ_{GL} for which the dominant term is oscillatory, but these oscillations are not related to those found by Eilenberger and Buettner in the isolated vortex problem for small κ_{GL}. From an analysis of these results, it is concluded that the absence of the Eilenberger–Buettner oscillations in the field-penetration problem cannot be used as an argument against their existence in other problems; in particular, a separate investigation is required for the isolated vortex problem. (auth)

44170 SUPERCONDUCTING PROPERTIES OF MONOCRYSTALLINE $NbSn_2$. Lazarev, B. G.; Matsakova, A. A. (Physical-Technical Inst., Kharkov). Dokl. Akad. Nauk SSSR; 203: No. 3, 560-2(21 Mar 1972). (In Russian).

Monocrystals of $NbSn_2$ were prepared by prolonged immersion of Nb in liquid Sn, and then characterized by x-ray studies. Their electrical resistance was measured over the range 2.5 to 2.6°K, and the resulting curve indicated that the transition temperature was 2.52°K. The resistance of the sample at 4.2°K was 3.2×10^{-4} ohm, and the ratio $R_{4.2^\circ}/R_{300^\circ} = 0.025$. The magnetization curve for $NbSn_2$ was obtained over the range 0 to 300 Oe, and the maximum occurred at 52 Oe (T = 1.79°K). (K.S.W.)

44171 SPACE QUANTIZATION IN THIN TIN FILMS. Komnik, Yu. F. (Physical-Technical Inst. of Low Temperatures, Kharkov); Bukhshtab, E. I.; Nikitin, Yu. V.; Chuprinin, F. I.; Sulkowski, C. Thin Solid Films; 11: No. 1, 43-51(Jul 1972).

The oscillatory dependences due to the quantum size effect of resistance and critical temperature for superconductivity on the thickness of thin tin films were studied. The temperature damping of the resistance oscillation amplitudes is in agreement with theoretical predictions. A complex character of the oscillations may be accounted for by the fact that space quantization is realized in several electron groups characterized by different momenta in the quantization directions. The periods of the three prominent harmonics were used to determine the extreme momenta of three electron groups in the [100] direction, which appeared to be very close in magnitude to the momenta in bands 4, 5, and 6 of the tin electron spectrum. (auth)

44172 PULSED FIELD LOSSES IN METAL-FILLED SUPERCONDUCTING MULTIFILAMENTARY BRAIDS. McInturff, A. D.; Dahl, P. F.; Sampson, W. B. (Brookhaven National Lab., Upton, N. Y.). J. Appl. Phys.; 43: No. 8, 3546-51(Aug 1972).

A summary is given of work on the application of metallic fillers to insulate and bond individual multifilamentary wires into a fully transposed conductor. As reported in earlier papers, conductors of this type have performed excellently in low-frequency pulsed magnets, but become "coupled" at relatively low values of $\dot{B}$, leading to high pulsed losses. Data are presented on metallic and intermetallic insulated braids showing excellent performance and exhibiting losses comparable to those of organically insulated braid for rise times less than 10 kG/sec. These conductors are also able to achieve 90% of short sample critical current at $\dot{B} \geq 200$ kG/sec, although their losses are significantly higher at these high rates of field change. (auth)

44173 CHEMISTRY OF HIGH-TEMPERATURE SUPERCONDUCTIVITY IN THE NbN FAMILY. Phillips, J. C. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys.; 43: No. 8, 3560-6(Aug 1972).

The high transition temperatures T_c of the family of RY compounds (R = Ti, Zr, Hf, V, Nb, or Ta, Y = C, N, or O) are attributed to softness of the lattice against hydrostatic deformations, which gives rise to strong electron longitudinal–acoustic phonon coupling at short wavelengths. Chemical trends within the RY family provide evidence to support this explanation. The microscopic theory of superconductivity is used to predict from the value of T_c the form of the phonon spectrum of NbN. For the acoustic branch the predicted value of $\langle\omega^2\rangle^{1/2}$ is 150°K. Also T_c^{max} in the RY family is estimated to be 22°K. (auth)

44174 PAIR TUNNELING AS A PROBE OF ORDER-PARAMETER FLUCTUATIONS IN SUPERCONDUCTORS: ZERO MAGNETIC FIELD EFFECTS. Anderson, J. T.; Carlson, R. V.; Goldman, A. M. (Univ. of Minnesota, Minneapolis). J. Low Tem. Phys.; 8: No. 1-2, 29-46(Jul 1972).

Thermal fluctuations of the order parameter in a superconductor above its transition temperature result in manifestations of the ordered state that appears below the transition. In a Josephson junction consisting of two metals with different transition temperatures, there is associated with the incipient superconductivity an enhanced conductivity across the junction at temperatures between the transition temperatures of the two metals. The enhanced conductivity is observed as a current that flows in excess of the junction quasi-particle current. The excess current was investigated using $Sn/Sn_xO_y/Pb$ and $Al/Al_xO_y/Pb$ junctions masked to eliminate effects of graded film edges. Details of the variation of the excess current with voltage and temperature are in quantitative agreement with calculations in the $Al/Al_xO_y/Pb$ junctions. The excess current—voltage characteristic is a direct measure of the imaginary part of the generalized susceptibility above T_c. The pair relaxation frequency in aluminum based on the data is consistent with the theoretical value. (auth)

44175 COMMENTS ON PROXIMITY EFFECT IN GADOLINIUM-BACKED LEAD FILMS. Hauser, J. J. (Bell Labs., Murray Hill, N. J.); Werthamer, N. R.; Smith, R. O.; McLean, W. L.; Serin, B. J. Low Temp. Phys.; 8: No. 1-2, 171-4(Jul 1972).

The use of the extrapolation length to characterize the boundary condition on the order parameter in previous work by Smith, et al. [J. Low Temp. Phys., 4: 317(1971)] is discussed, and the basis for justifying its use is criticized. (M.H.R.)

44176 IMPURITY DEPENDENCE OF THE ELECTRICAL RESISTIVITY IN THE INTERMEDIATE STATE. Grassie, A. D. C.; Allnutt, J. G.; Walton, A. J. (Univ. of Sussex, Eng.). J. Low Temp. Phys.; 8: No. 1-2, 97-104(Jul 1972).

Measurements were made of the electrical resistivity in the intermediate state of a superconducting cylinder of tin showing the resistivity to have the expected temperature and field dependence, but indicating that the dependence on the electron mean free path appears to be inadequately characterized by present theory. (auth)

44177 FLUX PENETRATION INTO A CYLINDER OF SUPERCONDUCTING INDIUM. Baird, D. C.; Wright, L. S. (Royal Military Coll., Kingston, Ont.). J. Low Temp. Phys.; 8: No. 1-2, 177-83(Jul 1972).

Magneto-optic techniques coupled with cinephotography were used to observe the kinetics of flux penetration into a cylinder of superconducting indium. (auth)

44178 MAGNETIZATION STUDIES OF TYPE-II SUPERCONDUCTORS. Rao, Coca T. Philadelphia; Temple Univ. (1971). 160p. University Microfilms Order No. 72-17,713.

Thesis.

Isothermal magnetization data were obtained for a series of well-annealed, chrome-plated Pb—In alloys of In composition ranging from 30 to 80 at.%, measured in the temperature interval from 1.90°K to the appropriate transition temperature. The validity of the empirical relation proposed by Toxen connecting the thermodynamic critical field data to the energy-gap measurements was examined in these alloys. This relation was found to hold over a wide range of values of the Ginzburg—Landau parameter, the electron mean free path, and over the entire region between the strong- and weak-coupling limits. Consequently, it appears to be valid to determine the energy gap at T = 0 from critical-field measurements, for both elemental and alloy superconductors. A method was found to compensate appropriately for the hysteresis in the magnetization curves at all temperatures. The experimentally determined Ginzburg—Landau parameters $k_1(T)$ and $k_2(T)$ show a stronger temperature dependence and are generally larger than predicted by existing weak-coupling theories. Magnetization studies on Pb 1.92—at.% Tl and high-purity niobium rods in longitudinal fields imply a sudden penetration of the magnetic field at the lower critical field H_{c1}, with a local magnetic induction B_{c1}. In transverse fields, the magnetization curves display a long linear region in the range $(1 - D)H_{c1} < H < H_t$, where H_t is the field at which the linear dependence terminates, D is the demagnetization coefficient of the sample. The hysteretic behavior is found to be qualitatively different for $H < H_t$ and $H > H_t$. These observations are explained by a model of superconducting and mixed-state regions. This model implies a first-order transition at H_{c1} when D = 0 or, equivalently, an attractive interaction between flux lines in both intrinsic and alloy type-II superconductors with a low Ginzburg—Landau parameter. Some controversy on the order of transition at H_{c1} in niobium persists. It is believed that, in presently available samples, a first-order transition cannot be observed directly but only inferred. (Diss. Abstr. Int., B)

Equipment and Devices

Refer also to abstract 44537.

44179 TEMPERATURE DEPENDENCE OF THE RESONANCE FREQUENCY OF A SUPERCONDUCTING LUMPED-PARAMETER CIRCUIT. Anan'ev, L. L.; Gerasimov, N. P.; Reinov, N. M.; Terent'eva, M. N. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 180-1(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 222-4(Jan 1972).

The temperature dependence of the dielectric constant of liquid helium and the temperature dependence of the depth of penetration of an electromagnetic field into a superconductor are considered in connection with the temperature stability of a superconducting lumped-parameter circuit. Results of an experimental investigation of the temperature dependence of the resonance frequency of a superconducting circuit made of niobium are given; the dependence of the position of the Meissner plunger introduced into the inductance coil is presented. The measurements are performed in the temperature range 4.2 to 1.8°K. (auth)

44180 STUDIES OF A GLASS—CERAMIC CAPACITANCE THERMOMETER BETWEEN 0.007 AND 0.040 K. Bakalyar, Donovan (Univ. of Minnesota, Minneapolis); Swinehart, Robert; Weyhmann, Walter; Lawless, W. N. Rev. Sci. Instrum.; 43: No. 8, 1221-3(Aug 1972).

It was found that the capacitance of a Corning type-1100 capacitance thermometer depends linearly on temperature from 7 to 25 mK, with an apparent sensitivity $dC/CdT \simeq 10^{-4}/mK$. (auth)

44181 CRITICAL CURRENT PERIODICITY OF JOSEPHSON JUNCTION INTERFEROMETERS. Stuehm, D. L.; Wilmsen, C. W. (Colorado State Univ., Fort Collins). J. Appl. Phys.; 43: No. 8, 3589(Aug 1972).

The critical current through a Josephson-junction interferometer is numerically computed taking into consideration the effect of applied and self-induced magnetic fields on the junctions and in the interference loop. The periodicity of the interference pattern is shown to be less than the flux quantum $\Phi_0 = hc/2e$. Quantitative results are given, illustrating the degree of deviation in periodicity from the flux quantum. (auth)

PHYSICS (NUCLEAR)

44182 VEROYATNOSTI ELEKTROMAGNITNYKH PEREKHODOV ATOMNYKH YADER (Z = 1 TO 30). (Probabilities of Electromagnetic Transitions of Atomic Nuclei (Z = 1 to 30)). Lan'ko, E. V.; Dombrovskaya, G. S.; Shubnyi, Yu. K. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1972). 703p.

The probabilities of nuclear transitions are tabulated in an extensive format, with the following experimental data systemized for all nuclear states: the excitation energy; spin, parity, isospin; the forms of discharge, their relative and absolute intensities; the half-lives, radiation widths, experimental matrix elements, deformation parameters, quadrupole moments, transition radii, methods of measurement, methods of excitation. All data are annotated by means of a assemblage of about 4,000 references. (tr-auth)

Neutron Interactions with Matter

Refer also to abstracts 44297, 44303, 44462, and 44485.

44183 (CINDU–10) CINDU: CATALOGUE OF NUMERICAL NEUTRON DATA AVAILABLE FROM THE IAEA NUCLEAR DATA SECTION. Lemmel, H. D. (ed.) (International Atomic Energy Agency, Vienna (Austria)). May 1972. 329p.

Supersedes CINDU–9.

The experimental and evaluated neutron data sets held at the IAEA Nuclear Data Section are indexed, and a list of data libraries in which these data sets are contained is given. Although tables of abbreviations and references are included, this volume is best read with the help of CINDA. (R.W.R.)

44184 (KURRI-TR–94) EXPERIMENTAL STUDY ON THE ENERGY SELECTION OF COLD NEUTRONS WITH MIRROR REFLECTION. Sugimoto, Masaaki; Utsuro, Masahiko (Kyoto Univ. (Japan). Research Reactor Inst.). 13 Jan 1972. 16p. (In Japanese). Dep. NTIS (U. S. Sales Only).

By making use of the wave-length dependency of total neutron reflection, the possibility of energy spectrum measurement of cold neutrons with a liquid-mirror reflection is first examined. The experimental results show qualitatively good agreement with those of a helical rotor type of neutron velocity selector, and further indicate a better energy resolution than that of the latter method in the cold-neutron energy region. The spectrum measurement by this mirror method necessitates an exact knowledge of the intensity of nonreflection, i.e., direct beam component, which can easily be measured in this experiment by generating small waves over the liquid surface with an ultrasonic vibrator. The usefulness of the mirror device for the effective separation of cold neutron component from the neutrons produced in reactors or cold moderators is then examined. Concerning this mirror type of cold neutron filter, the experiment gives a sufficiently intense neutron beam of an average energy below 1 meV, when a graphite thermal column is used as a source. (18 figures) (auth)

44185 (ORNL-TM–3646) XLACS: A PROGRAM TO PRODUCE WEIGHTED MULTIGROUP NEUTRON CROSS SECTIONS FROM ENDF/B. Greene, N. M.; Lucius, J. L.; White, J. E.; Wright, R. Q.; Craven, C. W. Jr.; Tobias, M. L. (Oak Ridge National Lab., Tenn.). 3 Apr 1972. 104p. Dep. NTIS.

XLACS calculates weighted multigroup neutron cross sections from ENDF/B data. Its primary design purpose is to produce full-energy-range multigroup libraries for the XSDRN program. Provisions are included for treating fast, resonance, and thermal ENDF/B data. Fine-group energy structures and expansion orders used to represent differential cross sections can be arbitrarily set by the user. Cross sections can be averaged over an arbitrary input weighting function or by any of several "built-in" functions. XLACS serves as the multigroup neutron cross section processing module in the AMPX system. XLACS is designed to run on the IBM 360—typical running times are several minutes. (auth)

44186 SOME IMPLICATIONS OF INFORMATION THEORY FOR MONTE CARLO CALCULATIONS. McCormick, N. J. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 15: No. 1, 268-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44187 TWO-DIMENSIONAL MULTIGROUP TRANSPORT BENCHMARK PROBLEM. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 269-70(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44188 GENERAL METHOD FOR SOLVING THE P_L EQUATIONS. Reed, Wm. H. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 271-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44189 ELIMINATION OF RAY EFFECTS IN CURVED GEOMETRIES. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 272-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44190 EFFECTIVENESS OF CONVERGENCE ACCELERATION OPTIONS IN TRANSPORT CALCULATIONS. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 273(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44191 TIME- AND SPACE-DEPENDENT NEUTRON SLOWING DOWN MODEL. Kang, Samsuk; Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 294-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44192 USE OF INTERPOLATORY POLYNOMIALS FOR A FINITE ELEMENT SOLUTION OF THE MULTIGROUP DIFFUSION EQUATION. Kaper, H. G.; Leaf, G. K.; Lindeman, A. J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 298-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44193 METALLIC GADOLINIUM FOR USE AS A THERMAL-NEUTRON FILTER. Kerr, H. T.; Jenkins, J. D. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 444-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44194 EFFECT OF VOIDS ON THERMAL-NEUTRON DIFFUSION LENGTH. Penn, C. S.; Stradling, L. J.; Cohen, L. D.; Bangs, A. J.; Brown, H. L. (Drexel Univ., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 1, 446-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44195 NEUTRON AGE PARALLEL TO SLABS IN A SLAB LATTICE OF TWO MATERIALS. Kalimullah, K. S. Ram (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 1, 447-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44196 NEUTRON SLOWING DOWN WITH INELASTIC SCATTERING. I. STEADY STATE. Lineberry, M. J.; Corngold, N. R. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 15: No. 1, 451-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44197 NEUTRON SLOWING DOWN WITH INELASTIC SCATTERING. II. TIME DEPENDENT. Corngold, N. R.; Lineberry, M. J. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 15: No. 1, 452-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44198 PROMPT-JUMP APPROXIMATION FOR NEUTRON SLOWING DOWN IN HEAVY MEDIA. Conn, Robert; Mohamed, Sawan (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 519-20(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44199 SOME NEW RESULTS IN TIME-DEPENDENT NEUTRON SLOWING DOWN THEORY. Conn, Robert; Sawan, Mohamed (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 520-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44200 INTERPRETATION OF 2.0- TO 2.57-MeV NEUTRON PULSE PROPAGATION IN IRON. Booth, R. S. (Oak Ridge National Lab., Tenn.); Perez, R. B.; Buhl, A. R.; Robinson, J. C.; Carroll, E. Trans. Amer. Nucl. Soc.; 15: No. 1, 530-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44201 COUPLED NEUTRON AND GAMMA RAY MULTIGROUP CROSS SECTION LIBRARY FOR USE IN SHIELDING CALCULATIONS. Morrison, G. W. (Oak Ridge National Lab., Tenn.); Straker, E. A.; Odegaarden, R. H. Trans. Amer. Nucl. Soc.; 15: No. 1, 535(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44202 APPLICATION OF DISCRETE ORDINATES TO NEUTRON COLLIMATOR ANALYSIS. Webb, R. M.; Karcher, R. H. (TRW Systems Group, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 548-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44203 PREPARATION OF FINE-GROUP COUPLED NEUTRON-GAMMA-RAY CROSS SECTIONS. Woolson, William A. (Science Applications, Inc., La Jolla, Calif.). Trans. Amer. Nucl. Soc.; 5: No. 1, 567-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44204 AMPX MODULAR CODE SYSTEM FOR GENERATING COUPLED NEUTRON-GAMMA MULTIGROUP CROSS-SECTION SETS. Greene, N. M.; Mynatt, F. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 568-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44205 MULTITABLE-MULTIGROUP PHOTON-PRODUCTION CROSS-SECTION COMPUTATION. Dudziak, Donald J. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 569-70(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44206 PROBLEMS AND TECHNIQUES IN COMPUTATION OF MULTIGROUP CROSS SECTIONS. LaBauve, R. J.; Weisbin, C. R.; Seamon, R. E.; Harris, D. R. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 570-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44207 PROCESSING ENDF CROSS SECTIONS FOR THE MONTE CARLO SOLUTION OF RADIATION TRANSPORT EQUATIONS. Lichtenstein, Henry; Troubetzkoy, E. S.; Beer, M. (Mathematical Applications Group, Inc., White Plains, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 571-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44208 PREPARATION OF DATA LIBRARIES FOR EFFICIENT RETRIEVAL BY CONTINUOUS-ENERGY MONTE CARLO CODES. Weisbin, C. R.; Harris, D. R.; Battat, M. E.; (and others) (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 572-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44209 MONTE CARLO EVALUATION OF MULTIPLE SCATTERING AND RESOLUTION EFFECTS IN DOUBLE-DIFFERENTIAL NEUTRON SCATTERING CROSS-SECTION MEASUREMENTS. Bischoff, F. G. (Rensselaer Polytechnic Inst., Troy, N. Y.); Yeater, M. L.; Moore, W. E. Nucl. Sci. Eng.; 48: No. 3, 266-80(Jul 1972).

A Monte Carlo computer code, MSC, has been developed which is of general usefulness in analyzing double-differential neutron scattering measurements. This code is equivalent to a three-dimensional solution of the neutron transport equation for finite geometries. It is available for two geometrical configurations (slab geometry and tubular geometry), and is readily adapted to other geometrical configurations. Resolution effects are calculated in detail by including full time dependence in the calculation and considering individually the various factors which contribute to the experimental resolution. MSC uses statistical weights as a means to improve the convergence of the Monte Carlo method by forcing scattering collisions; the statistical estimation technique used allows every collision to contribute to every scattered energy and angular bin. Options have been developed which treat rigorously the coherent and incoherent elastic scattering from poly crystals. Scattered energy and angle are sampled at each Monte Carlo collision by means of a new method which samples alpha and beta from the scattering law. This sampling technique is exact within the framework of numerical integration and interpolation. It permits full kernel calculations, yet requires the storage of only two-dimensional arrays. The use of this code led to changes in procedure in the double-differential neutron scattering cross-section experiments at Rensselaer. Because calculated experimental corrections are strongly model dependent, the data have not been corrected for resolution and multiple scattering effects. Instead, resolution-broadened multiple-scattered theory is compared with uncorrected data. This avoids the pitfall of data "corrections" which may, in fact, be strongly model dependent and bias the final results according to the model assumed for the calculation of the correction. This use of uncorrected data enhances the practical value of the measurements as a model testing device. Use of MSC has made it possible to obtain good scattering results with relatively thick samples for several materials, notably water, polyethylene, and uranium carbide. Some examples are given of the verification of the methods used. Experience gained by the use of MSC is summarized. (auth)

44210 MOTION INDUCED SHIFTS IN NEUTRON RESONANCE ABSORPTIONS. Ball, R. M.; Williamson, T. G. (Univ. of Virginia, Charlottesville). Nucl. Sci. Eng.; 48: No. 2, 225-7(Jun 1972).

Changes in the absorption rate of neutrons by nuclei resulting from changes in motion of those nuclei have been observed by rotating an absorbing foil of ^{176}Lu in a beam of thermal neutrons at rates up to 2×10^3 rps. An analysis is presented which is satisfactorily confirmed by the experimental results. (auth)

44211 MEASUREMENTS OF THERMAL-NEUTRON SPECTRA IN PLUTONIUM NITRATE SOLUTIONS. Neill, J. M. (Gulf Radiation Tech., San Diego, Calif.); Young, J. C.; Preskitt, C. A.; (and others). Nucl. Sci. Eng.; 46: No. 2, 244-54(Nov 1971).

Neutron spectrum measurements covering the range thermal to 3 keV were made by time-of-flight techniques in three solutions of plutonium nitrate. The concentrations and ^{240}Pu composition of these solutions were 197.9 g/liter at 23 wt %, 193.4 g/liter at 5 wt %, and 355.0 g/liter at 5 wt %. Flux traverses and time-dependent measurements were also made in each solution. The measured spectra are compared with theoretical calculations using the Haywood-II scattering kernel for H bound in H_2O and the ENDF/B Version I cross sections for ^{239}Pu. Good agreement is obtained for the two lowest concentrations. The disagreements for the highest concentration are ascribed to room return effects. (auth)

44212 ANISOTROPY OF DEPOLARIZATION OF A NEUTRON BEAM. Drabkin, G. M.; Okorokov, A. I.; Runov, V. V. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.): 15: No. 8, 324-6(20 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 8, 458-61(20 Apr 1972).

The anisotropy of the depolarization of a neutron beam on ferromagnetic domains of nickel at room temperature was observed. It is concluded that a distinct anisotropy of the depolarization is observed, and that the obtained values of α agree with the theoretical value $\alpha = 1.5$. (J.F.P.)

44213 NUMERICAL TREATMENT OF NEUTRON ELASTIC SLOWING DOWN. Cuculeanu, V. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 1, 31-7(1972).

The author suggests an algorithm for solving the neutron slowing-down equation with a general slowing-down kernel for heavy elements. (auth)

44214 SYNTHETIC SCATTERING KERNEL IN NEUTRON THERMALIZATION. Jauho, P.; Pitkaeranta, J.; Silvennoinen, P. (State Inst. for Technical Research, Otaniemi, Finland). J. Nucl. Energy; 26: No. 6, 287-91(Jun 1972).

An idealized scattering kernel introduction by Williams was studied analytically. When the energy dependence of the kernel was expressed in a particular separable form, a differential equation for the composite functions was derived. The solution of this equation was found to be of the confluent hypergeometric type. The remaining free constants were determined by requiring a constant total cross section. Based on a representation of the kernel in terms of Laguerre polynomials, the general energy moments were calculated. (auth) (UK)

44215 NON-EXPONENTIAL DECAY OF NEUTRON PULSES IN LOW TEMPERATURE BERYLLIUM. Ardente, V.; Rossi, G.; Pierini, P.; Riccobono, G. (CCR-EURATOM, Ispra, Italy). J. Nucl. Energy; 26: No. 6, 277-86(Jun 1972).

Measurements of the decay constant of a neutron pulse as a function of time were performed in beryllium blocks (15 × 15 × 20 cm^3 and 10 × 15 × 20 cm^3) at 20°C, at 155°K and at 90°K. At low temperature, in particular at 90°K, it was possible to follow the pulse evolution until 2.5 msec and the resulting λ(t) curve presented some well defined characteristics, which were suitable for a detailed theoretical discussion. In the framework of a phenomenological model it was shown that for a beryllium block of under-critical dimensions at low temperature a correct comparison between theory and experiments must take into account the spatial dependence of the problem. (auth)

44216 TIME-DEPENDENT NEUTRON SPECTRA FROM VERY COLD MODERATORS. Otomo, Norio; Inoue, Kazuhiko (Hokkaido Univ., Sapporo). Hokkaido Daigaku Kogakubu Kenkyu Hokoku; No. 64, 63-70(Mar 1972). (In Japanese).

The time-dependent multi-group transport equation has been solved analytically in a given small time interval, and the solution at any time can be obtained by the iterative procedure. The time behavior of the cold neutron pulses injected into the cold moderators has been studied using this method. For light-water ice and solid methane at very low temperature, the results of the calculation are in good agreement with the results of the pulsed neutron experiments in the whole region provided that the time-of-flight effect is considered. (auth) (Japan)

44217 THERMALIZATION OF NEUTRONS IN VERY COLD METHANE. Inoue, Kazuhiko (Hokkaido Univ., Sapporo). Hokkaido Daigaku Hogakubu Kenkyu Hokoku; No. 63, 99-104(Mar 1972). (In Japanese).

A scattering cross section is obtained for very cold solid methane. The hindered molecular rotation is assumed to be harmonic oscillation with a single frequency. The result is applied to calculate the cold neutron spectrum in very cold solid methane. The computed cold neutron spectrum shows better agreement with experiment than the one obtained with the assumption of free rotation. (auth) (Japan)

Nuclear Properties and Reactions, A ≦ 5

Refer also to abstracts 42967, 43989, 44217, 44231, 44341, and 44358.

44218 NATURE OF THE DEUTERON. McKee, J. S. C. (Birmingham Univ., Eng.). Phys. Bull. (London); 23: 349-50 (Jun 1972).

The deuteron is the nucleus of heavy hydrogen and is the simplest compound nucleus consisting of one neutron and one proton bound together. However nucleons (i.e., neutrons or protons) are not elementary particles with no sub-structure but are in fact particles in a state of continual change. The existence of a noncentral force resulting from a neutron–proton spin–spin interaction (the tensor force) and the anomalies caused by it are considered. The question whether mesonic effects are important to the deuteron and the existence of exchange currents within three body systems are considered. It is stated that the deuteron is in no sense an elementary particle anymore. It is a composite of nucleons and excited states of the nucleon in the deuteron and there is still much work to be done before D state and N* effects become unambiguously distinguished and before the two nucleon interaction is at last exactly solved. (UK)

44219 THREE-NUCLEON SYSTEM WITH THE REID AND GAMMEL–BRUECKNER POTENTIALS. Hennell, M. A.; Delves, L. M. (Univ. of Liverpool). Phys. Lett.; 40B: No. 1, 20-2 (12 Jun 1972).

Preliminary results for an extension of calculations to the Reid and Gammel–Brueckner nucleon–nucleon potentials are reported. The results for the Reid potential appear to disagree with those of some other calculations. (auth)

44220 TRINUCLEON ENERGY USING THE UNITARY POLE APPROXIMATION TO REID'S SOFT CORE POTENTIAL. Bhatt, S. C. (Rensselaer Polytechnic Inst., Troy, N. Y.); Levinger, J. S.; Harms, E. Phys. Lett.; 40B: No. 1, 23-6(12 Jun 1972).

Reid's deuteron wave function is used to find the unitary pole approximation to the $^3S_1-{}^3D_1$ t matrix for his local potential. This is used with the UPA to his $^1S_0$ potential; a trinucleon energy of −7.45 MeV and a doublet scattering length of 1.6 fm are found. (auth)

44221 PADE APPROXIMANTS AND NUCLEON–DEUTERON SCATTERING. Brady, T. J.; Sloan, I. H. (Univ. of Maryland, College Park). Phys. Lett.; 40B: No. 1, 55-7(12 Jun 1972).

The Padé approximant method of Kloet and Tjon is tested in a calculation of n–d scattering with separable potentials, where the exact result is already known. The method is found to work extremely well. (auth)

44222 QUALITY OF THE THREE-BODY WAVE FUNCTION OBTAINED WITH THE UNITARY POLE APPROXIMATION. Hadjimichael, E.; Harms, E.; Newton, V. (Fairfield Univ., Conn.). Phys. Lett.; 40B: No. 1, 61-4(12 Jun 1972).

It is shown that the three-body wave function obtained by means of the unitary pole approximation to the Reid potential retains the main features of the wave function obtained via the local Reid potential. The three-body s-state wave function is examined as a function of the spectator particle coordinate, ρ_3, and the two-body relative coordinate, r_{12}, by calculating charge and magnetic form factors and the two-body correlation function in the three-body system. The Coulomb energy of ^{3}He was also calculated and found to be 0.644 MeV. (auth)

44223 OPTICAL-MODEL AND DWBA APPLICATION TO THE FEW-NUCLEON PROBLEM. Devries, R. M. (CEN de Sacaly, Gif-sur-Yvette, France); Perrenoud, J. L.; Slaus, Ivo. Nucl. Phys.; A188: No. 3, 449-60(1972).

An attempt is made to describe p + d elastic scattering in the framework of the optical model. Angular distributions are analyzed in the energy range from 17 to 46.3 MeV. It is found necessary to take into account the contribution of elastic transfer, here calculated by means of DWBA. Total reaction cross section and the angular distribution of the reaction ^{2}H(p, d*)p are predicted and compared with experimental data. The success of this attempt suggests the possible use of the optical model and DWBA in few-nucleon problems. (auth)

44224 FURTHER INVESTIGATIONS OF OFF-SHELL EFFECTS IN THE TRITON. Fiedeldey, H.; McGurk, N. J. (Univ. of South Africa, Pretoria). Nucl. Phys.; A189: No. 1, 83-112 (1972).

The off-shell variation of the binding energy of the model triton E_T is investigated for exactly phase-equivalent separable potentials of rank two. A physical explanation for the large off-shell effects previously found in E_T is given which also explains the behavior of these potentials in nuclear matter as reported by Srivastava et al. The arbitrary attractive form factor g(k) is with one exception chosen to be equal to a Yamaguchi form factor with strength and range parameters γ and β, and binding energy E_B. With improved accuracy we can now show that E_T (γ,β) reaches a lower limit of about 8.2 MeV if $\gamma/\beta^2 \gg 1$ or $E_B \gg E_D$, the deuteron binding energy. This lower limit is shown to be independent of γ and only weakly dependent on β. The dependence on β is shown to be due to the far-off-shell behavior of the T-matrix. In general it is plausible that E_T is mainly determined by the near-on-shell T-matrix for short-range potentials. It is also shown that for all potentials with E_B significantly different from E_D the UPA is a good approximation and the deuteron wave function ψ_D does not differ greatly. Evidence is also provided that if ψ_D is given in addition to δ(k) and E_D then the T-matrix is nearly completely determined even if $E_B \approx E_D$. For those limiting potentials ($E_B = E_D$) which produce large values of E_T up to 16.2 MeV, the UPA is shown to fail completely, due to a mismatch between δ(k) and ψ_D. This explains the large values of E_T in those cases. All the limiting potentials are shown to be long-range potentials. It is also found that an approximately linear relation exists between E_T (if $E_B \neq E_D$) and the zero-energy wound integral I_0 in analogy with the nuclear-matter results of Haftel and Tabakin. (auth)

44225 STUDY OF d + d SCATTERING WITH THE RESONATING-GROUP METHOD AND AN IMAGINARY POTENTIAL. Chwieroth, F. S.; Tang, Y. C.; Thompson, D. R. (Univ. of Minnesota, Minneapolis). Nucl. Phys.; A189: No. 1, 1-19(1972).

The elastic scattering of deuterons by deuterons is considered with the resonating group method. The existence of reaction channels is approximately taken into account by introducing into the resonating-group formulation a phenomenological imaginary potential. For the deuteron wave function, a flexible three-Gaussian function is used, with the parameters adjusted to minimize the expectation value of the deuteron Hamiltonian. This particular deuteron function yields a very satisfactory behavior for the form factor and its use in the d + d calculation is shown to produce results very close to those which would be obtained if the deuteron eigenfunction were used. Comparison with experiment is made at 6.9, 12.65, 17.45 and 19.9 MeV. At all these energies, rather good agreement with the experimental differential and reaction cross-section data can be obtained. The imaginary potential is found to be energy dependent and contain a strong odd-even orbital-angular-momentum dependence. Without this odd-even dependence, it is shown that the diffraction minimum, observed experimentally at around 70°, cannot be reproduced. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 44217, 44259, 44260, 44283, 44343, 44346, 44350, and 44357.

44226 (ORO–3948-4) PION INTERACTIONS AT MEDIUM ENERGIES. Progress Report. Allred, John C.; Goodman, Clark (Houston Univ., Tex.). 1 Jun 1972. Contract AT(40-1)-3948. 39p. Dep. NTIS.

Experimental and theoretical studies of nuclear structure and reaction mechanisms at intermediate energies were continued. Experiments were carried out at the Space Radiation Effects Laboratory on proton and $\pi^{\pm}$ multiple scattering and $\pi^{\pm}$–^{12}C scattering in the nuclear–Coulomb interference region; π^{+} activation cross sections were also measured for several elements. Seven proposals were submitted to LAMPF, and six were assigned beam time within the first year of operation. The seventh was approved, but beam time was deferred until completion of one of the prior experiments. An improved readout system for multiscintillator detectors was invented. A laboratory course to familiarize students with modern nuclear physics equipment was conducted. The experimental work was done in collaboration with G. C. Phillips and his colleagues at Rice University. (auth)

44227 EXPERIMENTAL AND COMPUTATIONAL VARIABLES IN CROSS-SECTION EVALUATION. Meyer, Walter; Seck, R. E. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc.; 15: No. 1, 526-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44228 STUDY OF THE LEVELS OF ^{19}O. I. EXPERIMENT. Fasla, M.; Beaumevieille, H. (Institut d'Etudes Nucleaires, Algiers). Nuovo Cim.; 9A: No. 4, 547-60(21 Jun 1972). (In French).

Absolute differential cross sections for the proton groups $p_{0\rightarrow 2}$ from the ^{18}O(d,p)^{19}O reaction have been measured at 3 MeV deuteron energy, using a gas cell containing ^{18}O. A DWBA analysis of the above data and along with existing data for the $p_{0\rightarrow 9}$ groups was used to confirm the previous assignments of l_n angular orbital momentum of the ground state, 0.097, 1.470, 3.157, 3.944 MeV states. Spectroscopic factors have been obtained for the ground state and the excited states in ^{19}O at 0.097, 1.470, 3.157, 3.237 and 3.944 MeV. These results are compared with nuclear-structure predictions in the following paper. (auth)

44229 STUDY OF THE LEVELS OF ^{19}O. II. THEORY. Allard, J. F.; Bendjaballah, S.; Desgrolard, P.; Hammann, T. F. (Institut d'Etudes Nculeaires, Algiers). Nuovo Cim.; 9A: No. 4, 561-77(21 Jun 1972). (In French).

A systematic and complete study of the energy spectrum and the electromagnetic properties of the ^{19}O nucleus is presented. Microscopical or phenomenological models with axial or spherical symmetry cannot explain the whole of the known experimental results. A shell model calculation in the reduced $d_{5/2}$-$s_{1/2}$ space leads to energy levels too close with respect to the experiment. Two realistic interactions give similar results in this approximation. A $7/2^{+}$ level is obtained at too low an energy, as well as with an axial symmetrical rotational model of the Scholz–Malik type. The rotational bands obtained by the Peierls–Yoccoz projection of Hartree–Fock wave functions do not explain this level well. It is shown in the framework of a unified asymmetrical rotational model, that ^{19}O is probably greatly deformed, with a maximum nonaxiality, and that the level known at 2.37 MeV may have a $7/2^{+}$ spin. This level, together with the $9/2^{+}$ observed at 2.777 MeV, belongs to the asymmetrical rotational band built on the ground state. This model predicts a $3/2^{+}$ level at 2.59 MeV with a short lifetime. Reduced matrix elements and branching ratios of various electromagnetic transitions, calculated in the hypothesis of an asymmetric rotating core, agree closely with the known experimental results. It is possible, in the framework of this model, to invert the levels $7/2^{+}$ and $9/2^{+}$, which has been proposed recently by experimentalists. (auth)

44230 DIFFERENTIAL CROSS SECTIONS FOR THE ^{11}B(α,n_0)^{14}N REACTION AT 12 TO 15 MeV. Ciocanel, A.; Corcalciuc, V.; Duduleanu, E.; (and others) (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 1, 107-9(1972).

Angular distributions were measured from 0 to 130° in 10° steps for the ^{11}B(α,n_0)^{14}N reaction at 6 neutron energies between 12 and 15 MeV. The features of the angular distributions were analyzed for information on the reaction mechanism. (J.W.R.)

44231 ANGULAR MOMENTUM MATCHING FOR ALPHA-PARTICLE SCATTERING. Sharaf, M. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett.; 40B: No. 1, 5-6(12 Jun 1972).

The scattering amplitude for $\alpha-\alpha$ scattering is evaluated using a suitable form for the scattering function, η_l, taking into account the angular momentum matching of the absorbed partial waves. (auth)

44232 POSSIBLE QUASI-MOLECULAR ROTATIONAL BANDS IN sd-SHELL NUCLEI. Arima, A. (State Univ. of New York, Stony Brook); Scharff-Goldhaber, Gertrude; McVoy, K. W. Phys. Lett.; 40B: No. 1, 7-10(12 Jun 1972).

Analysis of elastic ^{12}C + ^{12}C and ^{16}O + ^{16}O scattering suggests the presence of families of shape resonances, which are found to lie on rotational bands. They are compared with the corresponding ground-state bands, and alternative means of exciting them are suggested. (auth)

44233 ELASTIC PION–NUCLEUS SCATTERING AND THE INFLUENCE OF THE FERMI MOTION. Mach, R. (Inst. of Nuclear Physics, Rez, Czech.). Phys. Lett.; 40B: No. 1, 46-8(12 Jun 1972).

By taking into account the motion of the target nucleons additional terms in the Kisslinger optical potential are obtained. These terms considerably improve the agreement with experimental data at large scattering angles; this improvement is demonstrated by calculation of elastic π^{-}–^{12}C scattering at 69.5, 80, and 87.5 MeV. (auth)

44234 QUASI-FREE ELECTRON SCATTERING AND THE INDEPENDENT PARTICLE MODEL. Radhakant, S. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 40B: No. 1, 70-2(12 Jun 1972).

The missing-energy spectrum for the reaction ^{12}C(e,e′p)^{11}B is studied using the independent particle model. It is shown that this cross section is quite sensitive to the bound-state wave function. The apparent incompatibility between quasi-free and elastic electron scattering data is removed if realistic wave functions are used. For ^{12}C, there is no need to invoke short-range correlations for comparing the two processes, at least for the momentum transfers for which experimental data are available. (auth)

44235 OPTICAL-MODEL ANALYSIS OF ^{6}Li ELASTIC SCATTERING. Bassani, G. (CEN de Saclay, Gif-sur-Yvette, France); Saunier, N.; Traore, B. M.; (and others). Nucl. Phys.; A189: No. 2, 353-67(1972).

The cross sections for elastic scattering of 28-MeV ^{6}Li ions by the nuclei ^{11}B, ^{12}C, and ^{13}C were analyzed using the optical model. The analysis was extended to other ^{6}Li elastic scattering data on ^{16}O (29.8 MeV) and on ^{12}C (24.5 and 30.6 MeV) previously measured elsewhere. The fits obtained with the usual six-parameter Woods–Saxon potential are good. Parameter ambiguities were studied, and the results of the analysis were compared with the predictions of the folding model. (10 figures, 3 tables) (auth)

44236 (d,^{6}Li) REACTIONS AT 28 MeV ON SOME LIGHT NUCLEI. Bedjidian, M.; Chevallier, M.; Grossiord, J. Y.; (and others) (Univ., Claude Bernard, Lyon). Nucl. Phys.; A189: No. 2, 403-8 (1972). (In French).

The (d,^{6}Li) reactions on ^{12}C, ^{16}O, ^{19}F, and ^{40}Ca were studied at 28 MeV incident energy. The angular distributions were obtained between 4° and 70° c.m. for the ground states and two excited-state transitions. A DWBA analysis was carried out which assumed the transfer of an α particle in the zero-range approximation. Relative spectroscopic factors are compared with Yoshida's calculations. (1 figure, 3 tables) (auth)

44237 LEVELS OF ^{11}Be FROM A STUDY OF THE ^{9}Be(t,p)^{11}Be REACTION. Ajzenberg-Selove, F. (Univ. of Pennsylvania, Philadelphia); Casten, R. F.; Hansen, O.; Mulligan, T. J. Phys. Lett.; 40B: No. 2, 205-7(26 Jun 1972).

The reaction ^{9}Be(t,p)^{11}Be has been studied with 20 MeV tritons and an Elbek-type spectrograph. Four previously unreported proton groups were observed corresponding to $E_x = 5.25$, 6.51, 6.72 and 8.84 MeV in ^{11}Be, and two broader groups. (auth)

44238 IMPULSE-APROXIMATION TREATMENT OF ALLOWED MUON CAPTURE IN ^{6}Li. Mukhopadhyay, N. C. (Univ. of Chicago. Argonne National Lab., Ill.). Phys. Lett.; 40B: No. 2, 157-60(26 Jun 1972).

The rate of the reaction $^{6}\mathrm{Li} + \mu^{-} \rightarrow {}^{6}\mathrm{He(g.s.)} + \nu_{\mu}$ is calculated with Cohen–Kurath shell-model wave functions. Calculated without the tensor term, it agrees with experiment if the oscillator root-mean-square radius is within the range $2.10\ \mathrm{fm} \leq r_0 \leq 2.76\ \mathrm{fm}$. The axial-vector form factor and Gamow–Teller operator dominate the reaction. (auth)

44239 MICROSCOPIC CALCULATION OF CROSS SECTIONS FOR THE REACTIONS ^{12}C(p,2p) AND ^{16}O(p,2p). Wille, U.

(Freie Univ., Berlin. Hahn-Meitner-Institut fuer Kernforschung, Berlin); Lipperheide, R. Nucl. Phys.; A189: No. 1, 113-54(1972).

Cross sections for the reactions $^{12}C(p,2p)$ and $^{16}O(p,2p)$ have been calculated in the framework of a model which takes explicit account of nucleon—nucleon correlations and of the decay of the residual nucleus by particle emission. The calculations are performed in the plane-wave impulse approximation and are based on the relation between the (p,2p) cross section and the energy-momentum spectral function of the target nucleus. The spectral function is determined in terms of the mass operator which is computed up to second order in a shell-model space including both bound and continuous single-particle states. The two-body interaction is assumed to be a spin-dependent zero-range force. Ground state correlations in the target nucleus are neglected. The calculated (unaveraged) separation-energy spectra exhibit isolated resonances with widths up to several hundred keV. The strength of the 1s and 1p hole states is distributed over a wide range of energies. The results indicate the importance of including ground-state correlations for the discrete part of the hole spectrum. The approximations used in the calculation and possible improvements are discussed. (auth)

44240 STRUCTURE OF ^{14}N AND ^{16}O. Latorre, C. D.; Irvine, J. M. (Univ. of Manchester, Eng.). Nucl. Phys.; A188: No. 3, 524-34(1972).

Using an empirical single-particle spectrum from ^{13}C and the Cornell local density-dependent approximation to the nuclear reaction matrix, two-particle and four-particle model-space configuration-mixing calculations are carried out for ^{14}N and ^{16}O. Correlations are allowed for in the ^{12}C core. The spectrum of ^{14}N is reasonably well reproduced. If the $d_{5/2}$ state is excluded from the model space the structure of ^{16}O is not well represented. However, there is a dramatic lowering of the energy of the rotational bands when the $d_{5/2}$ state is included and the spectrum of ^{16}O is given extremely well without any free parameters. (auth)

44241 TRANSFER REACTIONS BY HEAVY IONS AND FINITE-RANGE DWBA CALCULATIONS. Bock, R.; Yoshida, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Marburg, Ger.). Nucl. Phys.; A189: No. 1, 177-92(1972).

Experimental data of one-, three- and four-nucleon transfer reactions induced by the heavy-ion projectiles ^{16}O and ^{19}F on the targets ^{11}B and ^{12}C are analyzed within the framework of finite-range DWBA. In many-nucleon transfer reactions, the cross section is composed of the coherent sum of amplitudes corresponding to the transfer of clusters with different intrinsic states. The spectroscopic amplitudes are calculated using the results of the intermediate-coupling shell model. The calculated cross sections can reproduce the experiments fairly well in most cases. The method is compared with other approximations from the viewpoint of the selection rules for the angular-momentum transfer. (auth)

44242 MASS OF ^{15}O. Shamu, R. E.; Bernstein, E. M.; Blondin, D.; Ramirez, J. J. (Western Michigan Univ., Kalamazoo). Nucl. Phys.; A189: No. 1, 220-4(1972).

The $^{15}N(p,n)^{15}O$ threshold energy has been measured to be 3775.1 ± 0.8 keV, which is 5.7 keV lower than the presently accepted value. The resulting ^{15}O mass excess of 2856.4 ± 0.9 keV is 4.7 keV lower than the 1971 mass table value. (auth)

44243 LOCAL VERSUS NON-LOCAL t-MATRIX IN THE $^{14}N(p,2p)^{13}C$ REACTION AT 46 MeV. Chatterjee, A. K.; Deutchman, P. A. (Univ. of Idaho, Moscow). Nucl. Phys.; A189: No. 1, 20-34(1972).

The angular distributions for the $^{14}N(p,2p)^{13}C$ reactions at 46 MeV incident proton energy are calculated in the distorted wave t-matrix approximation (DWTA) where approximate optical-model waves are used. A comparison is made between the calculation using a local t-matrix to that of a non-local t-matrix. The (p, 2p) angular distribution is smaller in magnitude where a non-local t-matrix is employed compared to the calculation using a local t-matrix which implies that there is an overall enhancement of absorption associated with the non-local t-matrix. This also implies that differences between the local and non-local off-energy-shell effects can be significant. Parameter studies were undertaken for the distorted waves and bound state wave function and the effects on the angular distributions were similar in the local and non-local cases. The distortion effect due to the final-state focus phase dramatically changes the shape of the angular distribution. The calculations are considered to be a test of the off-energy-shell effects due to non-local interaction. This calculation is also a test of the approximate distorted waves at 46 MeV and the comparison to the $^{14}N(p, 2p)^{13}C$ data indicates that the distortion is reasonably well described. (auth)

44244 ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM ^{6}Li BETWEEN 25 AND 45 MeV. Bray, K. H. (Univ. of Manitoba, Winnipeg); Jain, Mahavir; Jayaraman, K. S.; (and others). Nucl. Phys.; A189: No. 1, 35-64(1972).

The elastic and inelastic scattering of protons from ^{6}Li has been studied at incident energies of 25.9, 29.9, 35.0, 40.1 and 45.4 MeV. The 2.18 MeV (3^+, T = 0) first excited state of ^{6}Li was found to be strongly excited, but the 3.56 MeV (0^+, T = 1) second excited state was quite weakly excited. Angular distributions for excitation of the 2.18 MeV level were measured at all five energies, while angular distributions for excitation of the 3.56 MeV level were extracted only at 25.9 and 45.4 MeV. To test the applicability of the optical model for the scattering of protons from such a light nucleus the elastic scattering angular distributions have been analyzed using the eleven-parameter search code SEEK. Available polarization angular distributions were included in the analysis. Reasonable fits to the data have been obtained with an average geometry potential. Theoretical estimates of the real part of the optical potential and the inelastic scattering differential cross sections have been made using the microscopic model for proton-nucleus scattering. Both phenomenological and realistic forces have been considered and the necessary nuclear transition densities have been extracted from experimental elastic and inelastic electron scattering data. An estimate of a possible spin-spin term in the optical potential has also been made. (auth)

44245 HALF-LIVES OF RADIONUCLIDES. IV. Emery, J. F. (Oak Ridge National Lab., Tenn.); Reynolds, S. A.; Wyatt, E. I.; Gleason, G. I. Nucl. Sci. Eng.; 48: No. 3, 319-23(Jul 1972).

Half-lives of 61 radionuclides have been determined. In general, the activity of a purified sample was followed for two or more half-lives, but specific activities were used for some long-lived nuclides. Statistical methods, usually least-squares, were employed to obtain estimates of uncertainties. No significant differences in decay rates of ^{24}Na, ^{64}Cu, or ^{131}I were found in various chemical states. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 43906, 44233, 44245, and 44260.

44246 (RLO—1388-172) ELECTROMAGNETIC DECAYS OF THE LOWEST T = 2 STATE IN ^{28}Al. Adelberger, E. G. (Princeton Univ., N. J. Joseph Henry Labs. Washington Univ., Seattle. Dept. of Physics); Balamuth, D. P. (Pennsylvania Univ., Philadelphia. Dept. of Physics). 1972. 12p. Dep. NTIS.

The gamma decays of the lowest 0^+, T = 2 state in ^{28}Al were studied using the reaction $^{26}Mg(^{3}He,p)^{28}Al$. Three branches to 1^+, T = 1 states were observed. Comparison is made to the analogous β and γ decays of the corresponding states of ^{28}Mg and ^{28}Si. (3 figures, 1 table) (auth)

44247 MEASUREMENTS OF THE TOTAL NEUTRON CROSS SECTION OF NATURAL SODIUM. Rahn, F.; Camarda, H.; Hacken, G.; (and others) (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 15: No. 1, 474-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44248 INVESTIGATION OF THE REACTION $^{28}Si(d,p)^{29}Si$ AT E_d = 10 MeV. El-Naiem, A.; Reif, R. (Zentralinstitut fuer Kernforschung, Dresden). Nucl. Phys.; A189: No. 2, 305-20 (1972).

An extensive DWBA analysis of the reaction $^{28}Si(d,p)^{29}Si$ at E_d = 10 MeV was carried out; transitions to final states in ^{29}Si up to excitation energy of 8.416 MeV were included. The orbital angular momentum transferred in the reaction and the absolute spectroscopic factors were determined from the differential cross sections by assuming spherical optical and bound-state potentials. Empirical rules for the j dependence of the angular distribution are used to give spin assignments. The sum rules and centers of gravity of the states were considered. To take into account collective effects, the transitions to strongly excited states are treated in a generalized DWBA model with deformed potentials by using an adiabatic approximation and neglecting the mixing of rotational bands. (6 figures, 4 tables) (auth)

44249 LOG ft VALUES FOR SECOND-FORBIDDEN β-TRANSITIONS AND THE DECAY OF ^{24}Na. Raman, S.; Gove, N. B.; Dickens, J. K.; Walkiewicz, T. A. (Oak Ridge National Lab., Tenn.). Phys. Lett.; 40B: No. 1, 89-91(12 Jun 1972).

The $4^+ \rightarrow 2_2^+$ β transition in ^{24}Na decay is important because it has been considered to have the lowest log-ft (10.7) for a second-forbidden β transition. This β transition is possible, but only a lower limit on the log-ft (>11.2) is really established; therefore, a revision of J^π assignment rules based on log-ft is appropriate. (auth)

44250 SHELL MODEL CALCULATIONS ON ATOMIC NUCLEI. Glaudemans, P. W. M. (State Univ., Utrecht). Ned. Tijdschr. Natuurk.; 38: 5-10(6 Jan 1972). (In Dutch).

A popular review is given of the surface delta interaction approach to shell model calculations. For s–d-shell nuclei the excitation energies and spectroscopic factors, as well as γ and β transition probabilities, have been calculated. Most of the calculated parameters fit the experimental values within the experimental error for the five lowest levels of ^{33}S. (Netherlands)

44251 STUDY OF COLLECTIVE STATES OF ^{32}S AND ^{34}S BY THE INELASTIC SCATTERING OF POLARIZED PROTONS. Lombard, Roselyne; Kamitsubo, Hiromichi; Raynal, Jacques; Gosset, Jean (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B; 274: No. 11, 761-4(13 Mar 1972). (In French).

Cross sections and analyzing powers of the first 0^+, 2^+ and 3^- states of ^{32}S and ^{34}S, excited in the inelastic scattering of polarized protons at 24.5 MeV, were calculated. A coupled-channel analysis using the vibrational model was performed. (France)

44252 STUDY OF LOW-LYING LEVELS IN ^{37}Ar. Taras, P.; Turcotte, A.; Vaillancourt, R. (Univ. of Montreal). Can. J. Phys.; 50: No. 11, 1182-94(1 Jun 1972).

The properties of the first five excited levels in ^{37}Ar were investigated via the ^{37}Cl(p,n)^{37}Ar reaction at E_p = 3.98, 4.17, 4.38, and 4.81 MeV and via the ^{34}S(α,n)^{37}Ar reaction at E_α = 8.00, 8.50, and 8.60 MeV. The following excitation energies were obtained: E_x = 1409.7 ± 0.4, 1611.5 ± 0.4, 2217.8 ± 0.8, 2491.4 ± 0.8, and 2797.0 ± 0.8 keV. These levels were found to decay almost entirely to the ground state. The angular distribution and the linear polarization of the decay gamma rays of these levels were measured. From these measurements definite spin–parity assignments as well as values of the mixing ratio of the ground-state gamma-ray transitions were obtained. These are $E_x(J^\pi,\delta)$ = 1612 ($7/2^-$, +0.11 ± 0.02), 2218 ($7/2^+$, 0.0 ± 0.02), 2491 ($3/2^-$, $+0.08^{+0.05}_{-0.12}$), and 2797 ($5/2^+$, −0.16 ± 0.03 or +8.0 ± 1.5, the value of −0.16 being more probable). The measurements were also consistent with a spin of 1/2 for the 1410-keV level. The results are compared with a recent shell-model calculation and are discussed in the context of the solar-neutrino capture rate in ^{37}Cl. (auth) (Canada)

44253 ALPHA-DECAY WIDTHS OF ^{20}Ne. Arima, A. (State Univ. of New York, Stony Brook); Yoshida, S. Phys. Lett.; 40B: No. 1, 15-19(12 Jun 1972).

Based on harmonic-oscillator shell-model wave functions, α widths are calculated for the ^{20}Ne ground-state band and other levels. The SU$_3$ shell-model wave function is rewritten as an α-cluster form, and the tail of the relative ^{16}O and α cluster wave function is improved by introducing a Woods–Saxon type effective potential. The calculated results are in good agreement with experimental data; detailed features are discussed. (auth)

44254 CONSISTENCY OF THE SU$_3$ MODEL AND CORE POLARIZATION EFFECTIVE CHARGE. Harvey, M. (Chalk River Nuclear Labs., Ont.). Phys. Lett.; 40B: No. 1, 77-80(12 Jun 1972).

Core polarization of the deformed oscillator leads (via Bloch–Horowitz procedure) to the strength of the $\widetilde{Q}\widetilde{Q}$ potential of the SU$_3$ model. Moments of inertia are those for rigid bodies. Spectra are compared with projected unrestricted Hartree–Fock calculations and experiment. (auth)

44255 $J^\pi = 6^-$ BOUND STATE OF ^{36}Ar. Hokken, G. A.; Endt, P. M. (State Univ., Utrecht). Phys. Lett.; 40B: No. 2, 195-7(26 Jun 1972).

Two resonances in the ^{35}Cl(p,γ)^{36}Ar reaction with $J^\pi = 5^-$ and $5^{(-)}$ strongly decay to bound states at E_x = 6.22 and 7.35 MeV to which, from γ-ray angular distribution and DSA lifetime measurements, unambiguous assignments of $J^\pi = 5^-$ and 6^- have been made. Shell model calculations show that the four states in question mainly have the $d^3_{3/2}f_{7/2}$ configuration, with the three $d_{3/2}$ particles coupled to $J = 5/2$. (auth)

44256 DECAY OF THE 15.22 MeV, T = 2 STATE IN ^{28}Si. Jelley, N. A.; Anyas–Weiss, N.; Wormald, M. R.; Underwood, B. Y.; Allen, K. W. (Nuclear Physics Labs., Oxford). Phys. Lett.; 40B: No. 2, 200-2(26 Jun 1972).

The γ-ray decay of the lowest T = 2 state (0^+) in ^{28}Si at 15223 keV has been investigated with a Ge(Li) detector using the reaction ^{24}Mg(α,γ)^{28}Si. Transitions to 1^+, T = 1 levels in ^{28}Si at 11445 ± 3 (40%), 10901 ± 3 (43%), 10724 ± 3 (9%, T = (1)) and 10598 ± 3 (8%, T = (1)) keV excitation were observed and a comparison is made with a simple shell-model description of the T = 2 and T = 1 levels. Limits have been placed on Γ_{γ_1} and Γ_{p_0} and values are given for Γ, Γ_{α_1}, Γ_{p_1} and Γ_{p_2}. (auth)

44257 CONCERNING THE ANOMALOUS FERMI STRENGTH IN THE β^+-DECAY OF ^{20}Na AND MIRROR SYMMETRY IN THE MASS-20 MULTIPLET. Torgerson, D. F.; Wien, K.; Macfarlane, R. D. (Texas A and M Univ., College Station). Phys. Lett.; 40B: No. 2, 203-4(26 Jun 1972).

The β^+-strength in the decay of ^{20}Na to the isobaric analog state in ^{20}Ne has been measured precisely. Contrary to previous measurements, it has been found that essentially the full Fermi strength is associated with this transition. A test of mirror symmetry has also been made for the decay to the first excited state of ^{20}Ne. There is evidence of an asymmetry somewhat smaller than that expected from the Wilkinson systematics. (auth)

44258 BETA DECAY OF ^{24}Al AND ^{28}P. Detraz, C. (Univ. of Colorado, Boulder). Nucl. Phys.; A188: No. 3, 513-23(1972).

The β^+ decay schemes of ^{24}Al and ^{28}P have been investigated. Due to the use of a larger Ge(Li) detector than in the work of Armini et al., several new β-branches have been observed. The log ft values have been determined. Some improved excitation energies in ^{24}Mg and the γ-decay schemes of several ^{24}Mg levels are also reported. The super-allowed β-decay of ^{24m}Al to its analog in ^{24}Mg has been observed. The difference between the β-decays to anti-analog states in ^{24}Mg and ^{28}Si is attributed to the amount of configuration mixing in the wave functions of the nuclear states involved. (auth)

44259 STUDY OF ODD-A NUCLEI IN THE 2s–1d SHELL BY MEANS OF THE (γ, γ') REACTION. Shikazono, N.; Kawarasaki, Y. (Japan Atomic Energy Research Inst., Tokai). Nucl. Phys.; A188: No. 3, 461-87(1972).

Resonant scattering of photons from ^{19}F, ^{23}Na, ^{27}Al, ^{31}P, ^{35}Cl and ^{39}K has been studied. Bremsstrahlung produced by electrons from a linac was used as a γ-ray source and a Ge(Li) detector was used to detect the resonantly scattered γ-rays. For ^{19}F, ^{23}Na, ^{27}Al and ^{31}P, many γ-rays were observed in contrast to the results for ^{35}Cl and ^{39}K. The results were compared with 180° inelastic electron scattering data from which one can conclude that most of the observed γ-rays have M1 character. Transitions from some T = 3/2 states were found and the transition strengths and the decay properties of these states are discussed. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 44236, 44245, 44259, 44267, 44268, 44283, and 44344.

44260 (BNL–50331) WHAT WILL THE NEUTRON DO NEXT? SYSTEMATICS OF NEUTRON REACTIONS. Lecture Series Number 99. Pearlstein, Sol (Brookhaven National Lab., Upton, N. Y.). 17 Feb 1971. Contract AT(30-1)-16. 17p. Dep. NTIS.

The ancient alchemists looked for ways to change base metals into gold. Today, one way to cause elemental changes is through neutron bombardment of nuclei. The neutron is an especially suitable tool for nuclear applications since, unlike other particles, it easily penetrates the charge fields surrounding the nucleus to react with nuclei. At neutron energies easily produced in the laboratory about 20 neutron-induced reactions are possible, leading to the emission of protons, deuterons, tritons, and other light nuclei. The development of neutron technology has made possible the formation of selected nuclei and the release of energy in a controlled manner. This technology is often based on a phenomenological approach to the observed data rather than a deep understanding of nuclear forces. As a result, properties of neutron reactions can often be established from systematic patterns gleaned from experimental data. The general characteristics of neutron reaction data and the use of simple models to extend the range of application of these data are described. (24 figures) (auth)

44261 DIFFERENTIAL AND AREA ANALYSIS OF IRON TOTAL CROSS-SECTION MINIMA. Block, R. C.; Alfieri, K.; Turinsky, P. J. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 531-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44262 SIMPLIFIED FINITE SAMPLE CORRECTIONS TO DIFFERENTIAL GAMMA-RAY PRODUCTION CROSS SECTIONS. Rogers, V. C.; Mittler, A. (Lowell Technological Inst., Mass.). Trans. Amer. Nucl. Soc.; 15: No. 1, 532-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44263 COMPLEX FORM FACTORS IN NUCLEON TRANSFER REACTIONS. Shepard, J. R.; Edwards, F. M.; Kraushaar, J. J. (Univ. of Colorado, Boulder). Phys. Lett.; 40B: No. 1, 95-8 (12 Jun 1972).

The effect of an imaginary component in the form factor for (p,d) and (p,t) reactions is examined. By following a recently developed procedure, several inadequacies of the DWBA description of these reactions, particularly those involving L = 0 transfers, are largely overcome. (auth)

44264 HOLE STATES IN ^{55}Fe. Robertson, B. C.; Neilson, G. C.; McDonald, W. J. (Univ. of Alberta, Edmonton). Nucl. Phys.; A189: No. 2, 439-48(1972).

A number of low-lying levels in ^{55}Fe have been described as hole states. The lifetime of the first two hole states was measured using the direct-timing and Doppler-shift techniques, and the decay schemes of these and neighboring levels were measured. An unsuccessful search was also made for possible decays from a level which has been reported at an excitation of 2818 keV. The experimental information is compared with various calculations. (auth)

44265 INTERMEDIATE COUPLING APPROACH IN THE UNIFIED MODEL OF THE ^{39}K NUCLEUS. Wiktor, S. (Inst. of Nuclear Physics, Krakow). Phys. Lett.; 40B: No. 2, 181-4(26 Jun 1972).

The low energy levels of the ^{39}K nucleus are examined in the framework of the intermediate coupling model in which the $(d_{3/2})^{-1}$ proton hole is assumed to couple to the 2^+, 3^- and 5^- core states of the doubly magic ^{40}Ca nucleus. Comments concerning the parameters are made. In particular the coupling strength parameters are related to the dynamical deformation parameters obtained in coupled channels analysis of the inelastic scattering processes. (auth)

44266 STUDY OF THE (n,γ) REACTION IN THE MASS REGION A = 50 TO 63. Kopecky, J.; Abrahams, K.; Stecher-Rasmussen, F. (Reactor Centrum Nederland, Petten). Nucl. Phys.; A188: No. 3, 535-44(1972).

The circular polarization of γ-rays from the capture of polarized thermal neutrons in isotopically enriched targets of ^{50}Cr, ^{52}Cr, ^{54}Fe, ^{60}Ni and ^{62}Ni has been measured. The analysis of 36 primary transitions resulted in unambiguous spin assignments for 30 levels. Eight of these have not been reported previously: ^{51}Cr (E_x = 4.64 MeV), $J = 3/2$; ^{53}Cr(3.62 MeV), $J^\pi = 1/2^-$; ^{55}Fe(2.03, 3.03, 3.79 and 4.50 MeV); $J^\pi = 3/2^-, 3/2^-, 1/2^-$ and $1/2^-$; ^{61}Ni(2.00 MeV), $J = 3/2$; ^{63}Ni(1.32 MeV), $J^\pi = 3/2^-$. The γ-ray energies and intensities of the transitions have been measured. The ^{50}Cr, ^{52}Cr, ^{54}Fe, ^{60}Ni and ^{62}Ni(n,γ) reaction Q-values were determined to be 9262.0 ± 1.0, 7939.6 ± 0.9, 9297.8 ± 1.0, 7819.6 ± 0.8 and 6838.2 ± 0.7 keV, respectively. A significant correlation between the (d,p) and (n,γ) strength has been found for the $2p_{3/2}$ levels in even-odd nuclei, but not for the $2p_{1/2}$ levels. (auth)

Nuclear Properties and Reactions, $59 \leq A \leq 89$

Refer also to abstracts 44245, 44260, 44263, 44266, 44283, 44329, 44344, and 44362.

44267 (COO-3239-1) NUCLEAR CHEMISTRY RESEARCH OF HIGH ENERGY NUCLEAR REACTIONS AT CARNEGIE-MELLON UNIVERSITY. Annual Progress Report, 1971-1972. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry). 1 Jun 1972. Contract AT(11-1)-3239. 103p. Dep. NTIS.

CESIUM-133—proton reactions (p,xn) and (p,pxn) at 550 MeV, cross sections and differential recoil ranges from, (E), p. 49-62
—proton reactions at 550 MeV, cross sections for scandium production in, (E), p. 63-5
COPPER-63—carbon-12 reactions at 63.4 to 125.0 MeV, cross sections and product ranges from, (E), p. 17-22
—boron-11 reactions at 65.6 to 114.4 MeV, cross sections and product ranges from, (E), p.17-22
COPPER-65—carbon-12 reactions at 15.3 to 122.0 MeV, cross sections and product ranges from, (E), p.17-25
—boron-11 reactions at 60.6 and 114.6 MeV, cross sections and product ranges from, (E), p.17-25
MESONS (π^-)—reactions with nitrogen-14 and fluorine-14 at 190 MeV, cross sections for, (E), p.66-8
MESONS (π^+)—reactions with nitrogen-14 and fluorine-14 at 190 MeV, cross sections for, (E), p.66-8
NUCLEAR CHEMISTRY—research at Carnegie-Mellon University, 1971-1972, (E)
NUCLEAR PHYSICS—research at Carnegie-Mellon University, 1971-1972, (E)
NUCLEAR REACTIONS—momentum transfer in heavy-ion, kinematic analysis of, (E/T), p.64-75
VANADIUM-51—11 reactions at 51.0 to 112.1 MeV, cross sections and product ranges from, (E), p.17-22
—carbon-12 reactions at 62.4 to 121.1 MeV, cross sections and product ranges from, (E), p.17-22
—nitrogen-14 reactions at 36.2 to 140.3 MeV, cross sections and product ranges from, (E), p.17-22 (R.W.R.)

44268 (COO-3496-1) STUDIES OF NUCLEAR FISSION, LOW-ENERGY NUCLEAR REACTIONS AND TRANSURANIC NUCLEI. Progress Report, June 1, 1971-June 1, 1972. Huizenga, John R. (Rochester Univ., N. Y. Dept. of Chemistry). 1972. Contract AT(11-1)-3496. 85p. Dep. NTIS.

BERYLLIUM-7—electron-capture decay of, effect of chemical environment on decay constant for, (E)
COBALT-59—alpha inelastic scattering at 17 MeV, anisotropy in, (E)
COPPER-63—proton inelastic scattering at 12 MeV, effect of isospin on compound nucleus decay in, (E)
—proton reactions (p,α) at 12 MeV, effect of isospin on compound nucleus decay in, (E)
—alpha inelastic scattering at 17 MeV, anisotropy in, (E)
COPPER-65—proton inelastic scattering at 11 MeV, effect of isospin on compound nucleus decay in, (E)
—proton reactions (p,α) at 11 MeV, effect of isospin on compound nucleus decay in, (E)
GADOLINIUM-158—helium-3 reactions (He-3,d) at 25.5 MeV, deuteron spectra from, (E)
IRON-56—alpha inelastic scattering at 17 MeV, anisotropy in, (E)
LEAD-208—energy-level density in, effect of Strutinsky shell corrections on, (T)
NICKEL-60—alpha reactions (α,p) at 16.6 MeV, effect of isospin on compound nucleus decay in, (E)
—alpha inelastic scattering at 16.6 MeV, effect of isospin on compound nucleus decay in, (E)
—alpha inelastic scattering at 17 MeV, anisotropy in, (E)
NICKEL-62—alpha reactions (α,p) at 16.2 MeV, effect of isospin on compound nucleus decay in, (E)
—alpha inelastic scattering at 16.2 MeV, effect of isospin on compound nucleus decay in, (E)
—alpha inelastic scattering at 17 MeV, anisotropy in, (E)
NUCLEAR REACTIONS—preequilibrium statistical model for, effect of Pauli exclusion principle in, (T)
PLUTONIUM-242—energy-level density in, effect of Strutinsky shell corrections on, (T)
TERBIUM-155—energy levels from (He-3,d) and (α,t) reactions, (E)
TERBIUM-157—energy levels from (He-3,d) and (α,t) reactions, (E)
TERBIUM-159—energy levels from (He-3,d) and (α,t) reactions, (E)
TERBIUM-161—energy levels from (He-3,d) and (α,t) reactions, (E)
TIN-118—proton inelastic scattering at 14 MeV, analysis for reaction mechanism in, (E) (J.W.R.)

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44269 (FRNC-TH-172) STUDY OF THE DECAY OF ^{77}Ge AND EXCITED LEVELS OF ^{77}As. Poncet, Maryse (Nice Univ. (France). Faculte des Sciences). 1971. 114p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The γ decay spectra of ^{77}Ge was observed (mainly at low energies). 141 γ lines were identified, and in addition a dozen doubtful lines were observed. 44 of the 141 γ lines were observed for the first time. Previous ^{77}As decay schemes were improved by the addition of 7 new levels: 1555.8, 1970.9, 2358, 2373.5; 2391.7, 2423.7 and 2543.1 keV. Using this new scheme it was possible to interpret 129 γ transitions without ambiguity. 6 transitions were interpreted in terms of two possible transitions in the level scheme. It was possible to explain certain properties of isobaric nuclei of mass number 77 using the shell model and the hypothesis of strong spin-orbit coupling. The results obtained allow the spin and parity of a certain number of levels to be discussed (e.g. the 614.1 keV level was identified as $3/2^-$). (France)

44270 EFFECTS OF ISOBARIC-ANALOG RESONANCES ON THE MEAN LIFETIMES OF COMPOUND-NUCLEUS FINE STRUCTURE BY CRYSTAL BLOCKING IN GERMANIUM. Gibson, W. M. (Bell Telephone Labs., Murray Hill, N. J.); Hashimoto, Y.; Keddy,

R. J.; Maruyama, M.; Temmer, G. M. Phys. Rev. Lett.; 29: No. 1, 74-7(3 Jul 1972).

The crystal-blocking method for protons along a ⟨110⟩ axis of a 30-keV-thick Ge crystal has been used to show sizable effects on mean compound-nuclear lifetimes of (1) the enhancement of an isobaric-analog resonance, and (2) the spin of the final state excited by inelastic scattering. (auth)

44271 RADIATIVE WIDTHS OF SPIN-1 LEVELS IN THE Zn ISOTOPES. Metzger, F. R. (Franklin Inst., Swarthmore, Pa.). Nucl. Phys.; A189: No. 2, 409-16(1972).

By using electron bremsstrahlung in combination with a 45-cm^3 Ge(Li) detector, resonant scattering of photons by Zn was observed for 20 levels ranging in energy from 3 to 5 MeV. Based on the angular distributions and the absolute yields, the spins and widths of these levels were determined. For all levels a spin of 1 was found to be the most probable assignment. For the 1^+ states, the M1 ground-state transition strengths range from 0.006 to 0.06 s.p.u.; for the 1^- states, the strengths range from 10^{-4} to 10^{-3} s.p.u. (2 figures, 1 table) (auth)

44272 (t,p) REACTION ON THE ZINC ISOTOPES. Hudson, F. R. (Atomic Weapons Research Establishment, Aldermaston, Eng. Univ. of Bradford, Eng.); Glover, R. N. Nucl. Phys.; A189: No. 2, 264-84(1972).

Multichannel spectrograph studies of the (t,p) reaction on the Zn isotopes provided energy-level data, cross-section measurements, and many new spin and parity determinations. The systematics of the energy spectra of the even zinc isotopes is discussed. (8 figures, 10 tables) (auth)

44273 HALF-LIFE OF ^{78}Rb. Boswell, G. G. J.; Velandria, J. A.; Bilge, A. N. (Univ. of Salford, Eng.). J. Inorg. Nucl. Chem.; 34: No. 6, 2090-1(Jun 1972).

Observations on ^{78}Rb confirmed the energies of its gamma radiations reported earlier (Toeset and Aten, Radiochem. Acta. 9: 55(1968)); the half-life was determined as 8.6 ± 0.1m, which was significantly longer than earlier values. The ^{78}Rb activity was obtained by two different methods. In the first method natural Cu foils were irradiated with an 80 μA beam of 160 MeV oxygen ions in the Manchester University linear accelerator for 15m, the reactions being ^{63}Cu(^{16}O,n)^{78}Rb and ^{65}Cu(^{16}O,3n)^{78}Rb. In the second method a natural Zn target was similarly irradiated for 1 hr. (UK)

44274 EXCITATION FUNCTIONS FOR DEUTERON REACTIONS WITH ^{75}As. Roehm, H. F.; Muenzel, H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 34: No. 6, 1773-84(Jun 1972).

Excitation functions for (d,2n), (d,4n), (d,5n), (d,p), (d,p2n), (d,p3n) and (d,2p) reactions with ^{75}As were measured, using the 52 MeV deuteron beam from the Karlsruhe isochronous cyclotron. The experimental results were compared to calculations based on the statistical model, and a rough estimate was made of the contribution from direct reactions. (auth)

44275 TOTAL AND PARTIAL WIDTHS OF ISOBARIC ANALOG RESONANCES. Coker, W. R.; Bledsoe, H.; Tamura, T. (Univ. of Texas, Austin). Phys. Lett.; 40B: No. 2, 164-6(26 Jun 1972).

Total and partial widths and resonance mixing phases for $d_{5/2}$ analog resonances in ^{87}Rb, ^{89}Y, ^{91,93}Nb, ^{93,97}Tc are calculated in the framework of a nonorthogonal, optical-model basis in a shell-model theory of reactions. The proton optical potential used is identical to that with which the experimental resonance parameters were extracted, for ^{89}Y and ^{91}Nb where the most detailed and unambiguous experimental studies have been made. (auth)

44276 DIRECT EVIDENCE FOR THE 5.23 keV LEVEL IN ^{83}Rb. Morinobu, S. (Tokyo Inst. of Tech.); Ikegami, H. Nucl. Phys.; A189: No. 1, 170-6(1972).

The low-energy electron spectrum following the decay of ^{83}Sr was studied using a preacceleration technique in a sector-type double-focussing β-spectrometer. A new 5.23 keV transition of M1 character was found. From the e^--γ delayed coincidence measurement, a level with a half-life of 71.5 ± 0.8 ns was confirmed at 5.23 ± 0.09 keV in ^{83}Rb. (auth)

44277 ENERGY LEVELS IN ^{74}As FROM THE ^{75}As(p,d)^{74}As REACTION. Fournier, R. (Univ. of Ottawa); Hsu, T. H.; Kroon, J.; Hird, B.; Ball, G. C. Nucl. Phys.; A188: No. 3, 632-40(1972).

The ^{75}As(p,d)^{74}As reaction has been used to identify 23 excited states in ^{74}As. The l_n values, or mixture of l_n values, to 19 levels have been determined from DWBA fits. The spectroscopic sum rules show a neutron shell filling which is consistent with other N = 42 isotones. (auth)

44278 ^{64}Ge. Robertson, R. G. H.; Austin, Sam M. (Michigan State Univ., East Lansing). Phys. Rev. Lett.; 29: No. 2, 130-3(10 Jul 1972).

The new isotope ^{64}Ge has been produced via the reaction ^{64}Zn(^{3}He,3n)^{64}Ge, chemically isolated, and its decay studied. Since ^{64}Ge is therefore nucleon stable, it can in principle have an important role in the synthesis of mass 64 by α capture during explosive stellar events, as proposed by Arnett, Truran, and Woosley However, from the measured half-life (62.3 ± 2.0 sec) and β-decay systematics, it appears that this mechanism is probably responsible for a negligible fraction of the observed abundance of mass 64. (auth)

Nuclear Properties and Reactions, $90 \leq A \leq 149$

Refer also to abstracts 43098, 43473, 44245, 44260, 44267, 44275, 44288, 44293, 44295, 44297, 44329, 44344, and 44348.

44279 YIELD DISTRIBUTION OF RADIOACTIVE NUCLIDES PRODUCED BY PHOTOSPALLATION REACTIONS IN ^{133}Cs AND ^{139}La WITH 250 MeV BREMSSTRAHLUNG. Kato, Toyoaki (Tohoku Univ., Sendai); Tsai, Hui-Tuh. Kakuriken Kenkyu Hokoku; 4: No. 2, 122-35(Feb 1972).

The yields of various radioactive nuclides produced in ^{133}Cs and ^{139}La as a result of the (γ, xnyp) reactions with 250 MeV bremsstrahlung have been measured with the aid of radiochemical techniques in order to study the features of the photospallation reactions on nuclei in heavy mass region. When yields were plotted against the difference in mass between target and product nuclei, it has been found that the curves thus obtained showed a similar Gaussian form for any separated element and that the peak yields occurred at about three mass units to the neutron-deficient side of the valley of the beta-stability. Similarities were observed between the yield distribution patterns obtained and those by high-energy particles in this mass region. (auth) (Japan)

44280 SEARCH FOR NUCLEAR PENETRATION IN THE INTERNAL CONVERSION PROCESS OF THE 53-keV TRANSITION IN ^{144}Pr. Sahota, H. S. (Punjabi Univ., Patiala, India). Indian J. Phys.; 44: No. 11, 609-10(Nov 1970).

The K-shell electron intensity for the 53-keV transition in ^{144}Pr using measured K/L ratios for the 80- and 133-keV transitions along with the theoretical K/L ratio for the 53-keV transition and previous data on the L-shell intensity. Using this result, a penetration factor essentially equal to unity was determined for the transition. (J.W.R.)

44281 NUCLEAR MAGNETIC RESONANCE OF ^{124}Sb AND LONG-LIVED ^{120}Sb ORIENTED IN Fe. Callaghan, P. T.; Stone, N. J. (Clarendon Lab., Oxford). Phys. Lett.; 40B: No. 1, 84-6(12 Jun 1972).

Nuclear magnetic resonance was applied to radioactive Sb nuclei oriented in Fe at 15 mK. The ^{124}Sb resonance at 70.2 ± 0.1 MHz determines the ground-state moment to be ±1.19 ± 0.03 nm. The resonance at 51.5 ± 0.1 MHz in 6-day ^{120}Sb yields ±0.289 ± 0.008 for the ground-state g factor. (auth)

44282 ELASTIC AND INELASTIC SCATTERING OF 53.4 MeV HELIONS FROM ^{144}Sm. Woollam, P. B.; Griffiths, R. J.; Clarke, N. M. (King's Coll., London). Nucl. Phys.; A189: No. 2, 321-33(1972).

Differential cross sections were measured over a wide angular range for the scattering of 53.4-MeV helions from the ground and first four excited states of ^{144}Sm. An optical-model analysis of the elastic scattering data resolved some of the discrete potential ambiguities. A collective-model description of the inelastic data was applied through the DWBA and the SCA. The predictions of the DWBA agree well with data from the one-phonon states. Comparisons are made with SCA fits to data from the elastic scattering and the one- and two-phonon states. (7 figures, 4 tables) (auth)

44283 EMPIRICAL EVIDENCE FOR SHELL EFFECTS IN (n,p) AND (n,α) REACTION CROSS SECTIONS INDUCED BY 14-MeV NEUTRONS. Holmberg, P. (Univ. of Oulu, Finland). Z. Naturforsch.; 27b: No. 6, 1015-16(Jun 1972).

Cross sections for (n,p) and (n,α) reactions were analyzed as functions of the proton and neutron numbers of the target nuclei. When these numbers equal or approach those of a closed-shell structure, the cross section values tend to increase. Far from closed shells the cross sections are small. (1 figure) (auth)

44284 g-FACTOR OF AN ISOMERIC LEVEL IN ^{117}Sb. Menet, J.; De Saintignon, P.; Loiseaux, J. M.; Boudard, A. (Institut des Sciences Nucleaires, Grenoble, France). Phys. Lett.; 40B: No. 2, 192-4(26 Jun 1972).

The g-factor of an isomeric level in ^{117}Sb has been measured, in beam, by the differential perturbed angular correlation method with a pulsed magnetic field. The result is $|g| = 0.116 \pm 0.003$. (auth)

44285 NATURE OF THE PHOTOPROTON SPECTRA. Osokina, R. M. (Inst. of the Nuclear Geophysics and Geochemistry, Moscow); Yadrowski, E. L. Phys. Lett.; 40B: No. 2, 161-3(26 Jun 1972).

Two classes of the proton channels of dipole IAS in the even-even nuclei have been studied: the decay into the "one hole" and "two hole-one particle" states of the residual nucleus. The photoproton spectra for ^{114}Sn and ^{124}Sn have been calculated and compared with experiment. (auth)

44286 g-FACTOR EXPERIMENTS ON THE FIRST EXCITED 2^+ STATES IN ^{102}Ru, ^{106}Pd, AND ^{110}Cd. Johansson, K.; Karlsson, E.; Norlin, L.-O.; Windahl, R. A.; Ahmed, M. R. (Univ. of Uppsala). Nucl. Phys.; A188: No. 3, 600-8(1972).

The g-factors of the first 2^+ levels in ^{102}Ru, ^{106}Pd and ^{110}Cd have been remeasured with increased accuracy, using the perturbed angular correlation method and the radio-active mother isotopes dissolved in ferromagnetic lattices. The results are $g = \pm 0.408 + 0.034$, $g = +0.399 \pm 0.029$ and $g = +0.35 \pm 0.07$ respectively. Possible sources of error in the use of internal fields are discussed. (auth)

44287 COMMENT ON A p-WAVE ASSIGNMENT TO THE 301-eV NEUTRON RESONANCE OF ^{96}Zr. Ricabarra, M. D.; Turjanski, R.; Ricabarra, G. H. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Sci. Eng.; 48: No. 3, 370(Jul 1972).

Some inconsistencies in the p-wave assignment to the 301-eV neutron resonance of ^{96}Zr are discussed. This resonance is about 100 times wider than should be expected for a p-wave resonance. Possible explanations for this anomaly are discussed. (J.W.R.)

Nuclear Properties and Reactions, $150 \leq A \leq 189$

Refer also to abstracts 44245, 44268, 44283, and 44299.

44288 (JINR-P6-6426) MEASUREMENT OF EXCITED STATE LIFETIMES IN NEUTRON-DEFICIENT NUCLEI OF ^{165}Er, ^{163}Er, ^{157}Tb, ^{153}Gd, ^{151}Gd, AND ^{135}La. Afanas'ev, V. P.; Gromova, I. I.; Lebedev, N. A.; Morozov, V. A.; Muminov, T. M.; Fuya, Kh.; Khalikulov, A. B.; Khamraev, F. Sh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

Lifetimes were measured for the levels with energies of 47.2, 77.3, 242.9, 296.1, 297.3, 356.5, 507.3, 589.6, and 745.7 keV in ^{165}Er; 69.2, 83.9, and 104.3 keV in ^{163}Er; 60.8 and 326.4 keV in ^{157}Tb; 109.8 keV in ^{153}Gd; 108.7, 395.2, 575.3, 587.5, and 839.3 keV in ^{151}Gd; and 119.4 and 206 keV in ^{135}La. (auth)

44289 (JINR-P6-6441) EXCITED STATES OF ^{157}Dy POPULATED AT ^{157}Ho ($T_{1/2}$ = 14 MIN) DECAY. Vylov, Ts.; Gromov, K. Ya.; Zelinski, A.; Zuber, K.; Zuber, Ya.; Kuznetsov, V. V.; Potempa, A. V.; Fominykh, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

Gamma-ray spectra, conversion electron spectra, and gamma-gamma coincidence spectra were investigated in the decay of ^{157}Ho. More than 50 transitions were found. The decay scheme $^{157}\mathrm{Ho} \rightarrow {}^{157}\mathrm{Dy}$ is suggested. The levels with the energies of 0 keV ($3/2^-$), 60.8 keV ($5/2^-$), 147.8 keV ($7/2^-$), and 257.4 keV ($9/2^-$) for the ^{157}Dy ground-state rotational band $5/2^-$ (521) and the levels of 341.1 keV ($5/2^-$), 420.4 keV ($7/2^-$), and 515.6 keV ($9/2^-$) for the rotational band $5/2^-$ (523) were observed, as well as the levels 897.0 ($5/2^-$) and 990.4 ($7/2^-$) for the rotational band $5/2^-$ (512). The results are discussed and compared with the neighboring nucleus ^{159}Dy and with theoretical calculations. (2 figures, 5 tables) (auth)

44290 EVIDENCE FOR STRONG INELASTIC PROCESSES IN (p,t) REACTIONS ON DEFORMED NUCLEI. King, C. H. (Yale Univ., New Haven); Ascuitto, R. J.; Stein, N.; Soerensen, Bent. Phys. Rev. Lett.; 29: No. 1, 71-4(3 Jul 1972).

Large deviations between distorted-wave Born approximation predictions and measured ^{186}W(p,t) reaction cross sections are explained by inelastic excitations in the entrance and exit channels when the reaction is treated by means of a coupled-channel calculation. The results presented include transitions to the ground-state, β vibrational, and γ vibrational bands of ^{184}W. The presence of inelastic processes is shown to result in significant differences in angular distributions representing the same transferred angular momentum. (auth)

44291 PHENOMENOLOGICAL DESCRIPTIONS OF NUCLEAR ROTATIONAL SPECTRA IN THE SPIN REGION $I < 30$. Wahlborn, S. (Royal Inst. of Tech., Stockholm); Gupta, R. K. Phys. Lett.; 40B: No. 1, 27-31(12 Jun 1972).

The application of broken polynomial expressions in terms of the angular momentum is suggested from semiempirical considerations for describing rotational spectra at spin values $I < 30$. A three-parameter expression for the moment of inertia gives satisfactory fits to the ground-state bands of several even-even nuclides, including high-spin states ($I_{max} = 18$) recently identified. (auth)

44292 COULOMB DISSOCIATION OF RELATIVISTIC NUCLEI. Artru, X.; Yodh, G. B. (Univ. of Maryland, College Park). Phys. Lett.; 40B: No. 1, 43-5(12 Jun 1972).

The process of Coulomb dissociation of a high-energy (relativistic) nucleus in the field of a heavy nucleus is considered. For C and O against tungsten at 10 GeV/nucleon, it is shown to yield about 10% of the total inelastic cross section (a much bigger percentage if only peripheral reactions are considered). The behavior of the cross section in the very-high-energy limit is also considered. (auth)

44293 COUPLED-CHANNEL ANALYSIS OF 12 MeV PROTON SCATTERING ON $^{148\ 154}$Sm. Kurepin, A. B.; Schulz, H.; Wiebicke, H. J. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A189: No. 2, 257-63(1972).

The elastic and inelastic scattering of protons by ^{148,154}Sm was analyzed by using the coupled-channel program KASTOR, which contains a least-squares fitting procedure. The effect of a Fermi charge distribution for the target nucleus was investigated. The optical and deformation parameters obtained are in good agreement with those given in other investigations. (2 figures, 3 tables) (auth)

44294 DIRECT AND SEMI-DIRECT RADIATIVE CAPTURE OF NUCLEONS IN DEFORMED NUCLEI. Boisson, J. P., Jang, S. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A189: No. 2, 334-52(1972).

The theory of the direct and semi-direct (collective) radiative capture of nucleons is extended to the case of deformed nuclei. Particular attention is paid to the giant dipole resonance, excited by the coupling of the incident particle to collective vibrations of the target nucleus. Captured single-particle bound states in the deformed potential are calculated using the method which solves the coupled differential equations derived on the Kapur-Peierls basis. The cross sections are found to be quite sensitive to the choice of parameters used in the numerical calculation, such as the giant resonance widths, γ-absorption cross section, and strength of the isospin-dependent potential. Applications are made to the radiative capture of 14-MeV neutrons by ^{160}Gd and ^{238}U. Radiative capture of neutrons by ^{208}Pb and ^{159}Tb is also included to discuss some ambiguities in the choice of parameters and in the calculation of bound states. (4 figures, 4 tables) (auth)

44295 NUCLEON SEPARATION AND PAIRING ENERGIES, DECAY ENERGIES, AND ATOMIC MASSES FOR $59 \leq Z \leq 69$. Meredith, J. O.; Barber, R. C. (Univ. of Manitoba, Winnipeg). Can. J. Phys.; 50: No. 11, 1195-1218(1 Jun 1972).

A set of 45 precise determinations of doublet spacings in the mass spectra of rare-earth chlorides was combined with existing nuclear reaction and decay Q values and atomic mass data in a least-squares adjustment of atomic mass differences. For nuclides in the region $59 \leq Z \leq 69$ the following quantities were calculated: separation energies for the last pair of neutrons and for the last neutron (S_{2n}, S_n), the neutron pairing energy (P_n), separation energies for the last pair of protons and for the last proton (S_{2p}, S_p), the proton pairing energy (P_p), Q values for α and β^- decays, and the masses. The systematic variations of these quantities are illustrated and discussed. (auth) (Canada)

44296 RETARDED E1 TRANSITION WITH $\Delta K = 1$ IN ^{173}Hf. Andrejtscheff, W.; Manfrasz, P.; Schilling, K.-D. Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Phys. Lett.; 40B: No. 1, 92-4(12 Jun 1972).

The lifetime of the 198-keV state in ^{173}Hf was determined as $T_{1/2} = 300 \pm 30$ ns. The E1 transition probabilities are compared with theoretical predictions. (auth)

Nuclear Properties and Reactions, $190 \leq A \leq 219$

Refer also to abstracts 43692, 44268, 44283, 44294, and 44348.

44297 INTEGRAL TEST OF THE INELASTIC SCATTERING CROSS SECTIONS OF Pb AND Mo USING MEASURED NEU-

TRON SPECTRA. Shook, D. F.; Fieno, D.; Ford, C. H. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 1, 527-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44298 RECOIL STUDY OF TRANSFER REACTIONS: EVIDENCE FOR α AND ^{8}Be TRANSFERS IN ^{12}C REACTIONS WITH HEAVY NUCLEI (Au, Bi). Bimbot, R.; Gardes, D.; Rivet, M. F. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A189: No. 1, 193-219(1972).

Transfer reactions induced with ^{12}C ions in Au and Bi targets have been studied. The experimental technique involves the measurement of the cross sections, angular distributions, and recoil range at each recoil angle, of the heavy residual nuclei. The processes leading to the production of At isotopes in the case of a Bi target, and Tl and Bi isotopes in the case of an Au target, have been identified by means of a kinematic analysis of the experimental data. They appear to be 2p, α and ^{8}Be transfers from the projectile to the target, followed by the evaporation of neutrons. The cross section for ^{8}Be transfer was derived from experimental data and is significant, of the order of 100 mb. The cross section for α-transfer was estimated to 30 to 80 mb. All the observed characteristics of the residual nuclei produced through α and ^{8}Be transfers (cross sections, ranges and angular distributions) are in good agreement with the cross sections and angular distributions of the direct α-particles which are the projectile residues of these transfers, and which were observed by other authors. (auth)

44299 SEARCH FOR γ-RAY ISOMERISM IN NEUTRON-DEFICIENT ISOTOPES OF NUCLEI WITH Z = 69 TO 89. Conlon, T. W. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys.; A189: No. 1, 65-72(1972).

A search for isomeric activity in the half-life range 5×10^{-6} to 10 sec in neutron-deficient isotopes of the nuclei with Z = 69 to 89 produced principally by reactions of the form (^{12}C, 4 or 5n), was performed. The lower limit for the detection of a γ-ray isomer in this region is estimated as 0.2 mb for a pure isotopic target. Only one example of isomerism, most probably due to ^{214m}Ra was observed; the activity has a half-life of 57 μsec and is produced with a cross section of about 20 mb. The photon spectrum observed in this case is discussed and multipolarities assigned, although no definite conclusion is reached concerning the nature of the isomeric state. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 44260, 44268, 44294, and 44334.

44300 (COO-3001-11) SEARCH FOR (t,p) TRANSITIONS TO EXCITED 0^{+} STATES IN THE ACTINIDE REGION. Casten, R. F.; Flynn, E. R.; Garrett, J. D.; Hansen, Ole; Mulligan, T. J.; Bes, D. R. (Los Alamos Scientific Lab., N. Mex.); Broglia, R. A.; Nilsson, B. (State Univ. of New York, Stony Brook). 1972. 13p. Dep. NTIS.

The (t,p) reactions with ^{230,232}Th and ^{234,236,238}U were studied at 15 to 20 MeV bombarding energy. The known excited 0^{+} states in ^{232}Th, ^{236,238}U were not observed, nor was any excited 0^{+} strength located in ^{234}Th or ^{240}U. The previously reported strong L = 0 (p,t) transitions in this region as well as the weak L = 0 (t,p) strengths reported here constitute a strong indication of the existence of quadrupole pairing correlations in deformed superfluid nuclei. (2 figures) (auth)

44301 (JINR-P4-6443) EXCITATION OF 0^{+} STATES IN THE TWO-NUCLEON TRANSFER REACTIONS. Abdulvagabova, S. K.; Ivanova, S. P.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).

Spectroscopic factors are studied for the excitation of 0^{+} states in deformed nuclei in two-nucleon-transfer reactions. The qualitative explanation of the observed regularities in the relative excitation cross sections in the (p,t) reaction are shown to be obtained in the model with pairing and quadrupole forces. To reach quantitative agreement with the empirical data it is necessary (but not sufficient) to take into account the spin-quadrupole interactions. (1 figures, 3 tables) (auth)

44302 NUCLEAR PHYSICS USING SOLID-STATE NUCLEAR TRACK DETECTORS. Perelygin, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Trans. Amer. Nucl. Soc.; 15: No. 1, 116(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44303 DOPPLER-BROADENED INTERMEDIATE RESONANCES. Goldstein, Rubin (Combustion Engineering, Inc., Windsor, Conn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 291(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44304 IMPROVED ^{238}U RESONANCE PARAMETER EVALUATION FOR ENDF/B VERSION III. Durston, Colin (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 475-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44305 MULTILEVEL ANALYSIS OF THE ^{235}U FISSION AND CAPTURE CROSS SECTIONS. Perez, R. B. (Oak Ridge National Lab., Tenn.); de Saussure, G.; Kolar, W. Trans. Amer. Nucl. Soc.; 15: No. 1, 476-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44306 ^{235}U RESOLVED RESONANCE PARAMETERS FOR ENDF/B VERSION III. Smith, J. R.; Young, R. C. (Aerojet Nuclear Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 478-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44307 EVALUATION OF THE ^{239}Pu CROSS SECTIONS IN THE RESONANCE REGION FOR THE ENDF/B VERSION III DATA FILE. Simpson, O. D.; Simpson, F. B. (Aerojet Nuclear Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 479-80 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44308 NEUTRON FISSION AND ABSORPTION CROSS-SECTION MEASUREMENTS FOR ^{239}Pu AND ^{241}Pu. Weston, L. W.; Todd, J. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 480-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44309 MEASUREMENT OF NEUTRON FISSION CROSS SECTION FOR ^{239}Pu AND ^{235}U FROM 0.02 eV TO 200 keV. Gwin, R.; Silver, E. G.; Ingle, R. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 481-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44310 INTERACTIVE DISPLAY SYSTEM FOR EVALUATION OF MULTILEVEL RESONANCE PARAMETERS. Rose, P. F. (Atomics International, Canoga Park, Calif.); Adler, D. B.; Adler, F. T.; Marshall, N. H. Trans. Amer. Nucl. Soc.; 15: No. 1, 482(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44311 TRITIUM YIELDS FROM FAST-NEUTRON FISSION OF ^{235}U(200 TO 800 keV). Dudey, N. D.; Malewicki, R. L.; Rymas, S. J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 483(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44312 ^{235}U, ^{238}U, AND ^{239}Pu FAST FISSION YIELDS OF SHORT-LIVED GAMMA-ACTIVE NUCLIDES. Larsen, R. P.; Dudey, N. D.; Heinrich, R. R.; (and others) (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 483-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44313 EXISTENCE OF CORRELATION BETWEEN ENERGY SPECTRA AND MULTIPLICITY OF PROMPT-FISSION GAMMA RAYS. Gozani, T.; Costello, D. G. (Gulf Radiation Tech., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 484-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44314 HIGH PRECISION NEUTRON CROSS-SECTION RESEARCH AT THE CENTRAL BUREAU FOR NUCLEAR MEASUREMENTS. Deruytter, Achiel J. (EURATOM, Geel, Belg.). Trans. Amer. Nucl. Soc.; 15: No. 1, 490(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44315 PROGRESS ON NEUTRON CROSS-SECTION MEASUREMENTS AT KARLSRUHE. Cierjacks, S. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 15: No. 1, 490(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44316 NEUTRON CROSS-SECTION MEASUREMENTS USING THE 80-MeV SACLAY LINEAR ACCELERATOR. Michaudon, A. (CEN de Saclay, Gif-sur-Yvette, France). Trans. Amer. Nucl. Soc.; 15: No. 1, 490(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44317 FAST-NEUTRON SCATTERING. Perey, F. G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 490(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44318 RECENT U. S. PROGRESS IN MEETING THE NEEDS FOR NUCLEAR DATA. Moore, Michael S. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 490-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44319 GAMMA PRODUCTION CROSS SECTIONS FOR ^{238}U. Takahashi, Hiroshi (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 533-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44320 COMPLETION AND EXTENSION OF THE PERIODIC SYSTEM OF THE ELEMENTS. Segre, Emilio (Univ. of California, Berkeley). pp 49-71 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The development of the periodic table to its present state is briefly reviewed. The transuranium region is discussed in some detail. The techniques currently being used in attempts to produce superheavy nuclei are surveyed. Possibilities for extending the periodic table are evaluated. (J.W.R.)

44321 MEASUREMENT OF THE CAPTURE-TO-FISSION CROSS SECTION RATIOS OF ^{235}U AND ^{239}Pu WITH A NEW TECHNIQUE. Bandl, R. E.; Miessner, H.; Froehner, F. H. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Sci. Eng.; 48: No. 3, 324-30(Jul 1972).

The ratio of capture to fission cross section, α, has been measured for ^{235}U and ^{239}Pu in the neutron energy range from 8 to 60 keV. A pulsed neutron beam from a ^{7}Li Van de Graaff source was used. The absorption was found by a comparison of the scattered neutrons from the fissile sample with those from a nonabsorbing lead sample. The fast fission neutrons were simultaneously detected with an organic liquid scintillator. The normalization of the $\alpha(^{239}\mathrm{Pu})$ data was slightly changed with respect to the values reported earlier in the light of recent evaluations. (auth)

44322 MEASUREMENT AND NORMALIZATION OF THE RELATIVE ^{239}Pu FISSION CROSS-SECTION IN THE LOW RESONANCE REGION. Deruytter, A. J. (CBNM-EURATOM, Geel, Belgium); Wagemans, C. J. Nucl. Energy; 26: No. 6, 293-301(Jun 1972).

Measurements of the ^{239}Pu fission cross section were performed at a well-collimated short flight-path of the C.B.N.M.-Linac from 30 eV to below thermal energy for a direct normalization to the 2200 m/s reference cross-section. The fission reaction rate and the neutron spectrum were determined simultaneously with solid state detectors placed on each side of a back-to-back ^{239}Pu-^{10}B-layer. From the counting-rate ratios σ_f-curves were calculated assuming a 1/v behavior of the ^{10}B(n,α)^{7}Li cross-section. Several fission and resonance integrals were calculated from the normalized σ_f-curve and compared with other published results. It is shown that the large discrepancies between the reported results (up to more than a factor of 2) can be considerably reduced by applying a common normalization procedure, e.g., to the fission integral $\int_{9\,\mathrm{eV}}^{20\,\mathrm{eV}}\sigma_f(E)\,dE = 1046.6 \pm 10.4$ barn eV obtained from these measurements. (auth) (UK)

44323 NEGATRON HALF-LIFE ON THE LONG-LIVED ^{236}Np ISOMER. Engelkemeir, D. W.; Gindler, J. E. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem.; 34: No. 6, 1799-1804(Jun 1972).

The partial negatron half-life of the long-lived ^{236}Np isomer was determined by observing the growth of its ^{236}Pu daughter for a period of approximately 4 yr. The half-life obtained is $(1.29 \pm^{0.07}_{0.05}) \times 10^6$ yr. (auth) (UK)

44324 DETERMINATION OF THE NUCLEAR CHARGE DISTRIBUTION IN THE CHAIN 132 FROM THERMAL NEUTRON FISSION OF ^{235}U AND ^{233}U. Naeumann, R.; Folger, H.; Denschlag, H. O. (Univ., Mainz). J. Inorg. Nucl. Chem.; 34: No. 6, 1785-97(Jun 1972).

Fractional independent and fractional cumulative fission yields of the three principal constituents in the mass chain 132 produced by thermal neutron induced fission of ^{235}U and ^{233}U were investigated using rapid chemical separations of tin, antimony and tellurium as hydrides. Values measured are: ^{132}Sn (13.7 ± 0.8)% cumulative, ^{132}Sb (48.7 ± 1.0)% independent, and ^{132}Te (37.6 ± 1.5)% independent for the fission of ^{235}U, and ^{132}Sn (2.5 ± 0.5)% cumulative, ^{132}Sb (27.1 ± 3.0)% independent, and ^{132}Te (64.4 ± 4.0)% independent for the fission of ^{233}U. The half-life of ^{132}Sn was determined as 39.0 ± 1.0 sec. A Gaussian charge dispersion curve with a width parameter $\sigma = 0.59$ fitted to the measured yields gives Z_p-values of $51.28^{+0.10}_{-0.30}$ and $51.75^{+0.10}_{-0.15}$ or a deviation from unchanged charge density of $\Delta Z = -0.37^{+0.10}_{-0.30}$ and $\Delta Z = -0.34^{+0.10}_{-0.15}$ charge units for the fission of ^{235}U and ^{233}U, respectively. No pronounced local effects attributable to the closed 50-proton and 82-neutron shells were observed. (auth)

44325 LOWERING OF CALCULATED FISSION BARRIERS OF SUPERHEAVY NUCLEI. Kelson, I.; Shoshani, Y. (Tel-Aviv Univ., Israel). Phys. Lett.; 40B: No. 1, 58-60(12 Jun 1972).

The effect of angular momentum conservation is evaluated explicitly in the framework of models which utilize single-particle wave functions to calculate fission barriers. Through the use of simple assumptions and extrapolation from known data, the calculated superheavy barriers are lowered by 2 to 2.5 MeV. Fission barriers for the actinides are unaffected. (auth)

44326 LIGHT NUCLEI FROM ^{235}U NEUTRON FISSION. Vorobev, A. A.; Seleverstov, D. M.; Grachov, V. T.; (and others) (Leningrad Inst. of Nuclear Physics). Phys. Lett.; 40B: No. 1, 102-4(12 Jun 1972).

Yields and energy spectra of H, He, Li, Be, B, C, and O isotopes from ^{235}U neutron fission were determined. The data were analyzed by means of a fast scission model. (auth)

44327 NUCLEAR SPECTROSCOPY OF HIGHLY DEFORMED ^{231}Th. James, G. D.; Lynn, J. E.; Earwaker, L. G. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys.; A189: No. 2, 225-49(1972).

A measurement of the neutron-induced fission cross section of ^{230}Th was made in the neutron energy range 625 keV to 1.4 MeV with a neutron energy resolution of 5 keV. At selected energies near a prominent resonance at 715 keV, the angular distribution of fission products with respect to the neutron beam was measured with neutron energy resolution of about 18 keV. The results are interpreted in terms of a β vibration in the secondary minimum of the fission potential barrier and allow a direct estimate of the effective moment of inertia of the ^{231}Th nucleus in its shape isomeric state, as well as other spectroscopic information on the nuclear levels associated with this shape. (11 figures, 2 tables) (auth)

44328 GAMMA-NEUTRON COMPETITION IN THE DE-EXCITATION MECHANISM OF THE FISSION FRAGMENTS OF ^{252}Cf. Nifenecker, H.; Signarbieux, C.; Ribrag, M.; Poitou, J.; Matuszek, J. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A189: No. 2, 285-304(1972).

A multiparameter experiment, in which the kinetic energies of the fragments, the number of prompt fission neutrons, and the total γ-ray energy per fission were measured, was performed. The neutron multiplicity and the γ-ray measurements were made with the same large scintillator. A method which corrects the γ-pulse for the proton recoils caused by the fission neutrons is described. The results show that the γ energy decreases by about 0.1 MeV when the total kinetic energy of the fragments increases by 1 MeV. A linear relationship between the γ-ray energy emitted by a given fragment and the average number of neutrons emitted by the same fragment is suggested, namely, $E_\gamma(m,E_t) = 0.75\bar{\nu}\,(m,E_t) + 2$ (MeV). These results are interpreted as caused by a linear increase of the average spin of the fragments with their excitation energy. (8 figures, 1 table) (auth)

Nuclear Theory

Refer also to abstracts 42747, 42832, 42836, 44075, 44081, 44098, 44267, 44268, 44294, 44325, and 44603.

44329 (JINR-P2-6423) ON AN APPROXIMATE METHOD OF CALCULATION OF FAST ION AND NUCLEUS INTERACTIONS. Barashenkov, V. S.; Gavrilov, E. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

The Glauber-theory formulas for collisions of two nuclei are expressed in terms of the amplitude of the nucleon-nucleus interaction. Such an approach is applicable to the description of collisions between nuclei differing considerably in their nuclear dimensions in the energy range >200 to 300 MeV/nucl of the incident nucleus. The paths of fast α particles in a photoemulsion are calculated. (1 figure) (auth)

44330 IMPROVED METHOD FOR THE TREATMENT OF RESONANCE CROSS SECTIONS. Hwang, R. N. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 291-2 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44331 NEW SPACE-DEPENDENT FAST-NEUTRON MULTIGROUP CROSS-SECTION PREPARATION CAPABILITY. Stacey, W. M. Jr.; Toppel, B. J.; Henryson II, H.; (and others) (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 292-3 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44332 COMPARISON OF NUCLEAR DATA PROCESSING CODES. Kidman, R. B. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 295-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44333 ENERGY DISTRIBUTION OF NEUTRONS FROM (n,2n) REACTIONS. Odette, G. R. (Univ. of California, Santa Barbara). Trans. Amer. Nucl. Soc.; 15: No. 1, 464-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44334 PROMPT-NEUTRON EMISSION AND ASSOCIATED FISSION ENERGETICS RESULTING FROM THERMAL-NEUTRON FISSION. Lee, W.; Deutsch, R. W. (Catholic Univ. of America, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 485-7 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44335 THREE STEPS IN THE STRUCTURE OF MATTER. Weisskopf, V. F. (Massachusetts Inst. of Tech., Cambridge). pp 247-62 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

Three phenomenological classification or ordering schemes which have been of immense importance in understanding the nature of matter are discussed. These three schemes are the Mendeleev periodic system, the nuclear shell model, and the elementary particle scheme of Gell-Mann and Nishijima. The impact of each of these concepts is traced. The similarities between atomic, nuclear, and elementary particle spectra are pointed out. The limits to our knowledge of elementary particle structure are briefly discussed. (J.W.R.)

44336 SUPERFLUID NUCLEAR MODEL. Bogolyubov, N. N. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 263-74 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The formulation of the superfluid nuclear model is traced. The formalism is reviewed and the physical interpretations are discussed. (J.W.R.)

44337 SHELL MODEL AND ENERGIES OF NUCLEI AND ATOMS. Talmi, Igal (Weizmann Inst. of Science, Rehovot, Israel). pp 275-91 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

Binding energies and ionization potentials or nucleon separation energies for atomic or nuclear systems are discussed in terms of shell structure. The similarities and differences between atomic and nuclear shell structure are analyzed. (J.W.R.)

44338 CLASSIFICATION OF SHELL-MODEL STATES. Elliott, J. P. (Univ. of Sussex, Brighton, Eng.). pp 293-303 of Atti del Convegno Mendeleeviano. /Verde, M. (ed). Turin; Vincenzo Bona (1971).

From International Mendeleev congress; Turin, Italy (15 Sep 1969).

The features of atomic and nuclear forces which result in shell-model configurations are discussed. The use of group theory in classifying shell-model states is illustrated. The insights on atomic and nuclear structure offered by classification are described. (J.W.R.)

44339 EXCITATION SPECTRUM FOR NUCLEAR MATTER. Khanna, K. M.; Sharma, M. L. (Univ. of Dibrugarh, India). Czech. J. Phys.; 22: No. 5, 380-93(1972).

Properties of an infinite nuclear matter of interacting alpha-particle have been studied. The expression obtained for the excitation spectrum exhibits the existence of the energy gap in the nuclear matter. The energy gap changes with m_α^*/m_α, the ratio between effective and true mass of an alpha-particle, and it seems to disappear for higher values of m_α^*/m_α. (auth)

44340 PAIRING FLUCTUATIONS IN EXCITED NUCLEI AND THE ABSENCE OF A SECOND ORDER PHASE TRANSITION. Moretto, L. G. (Univ. of California, Berkeley). Phys. Lett.; 40B: No. 1, 1-4(12 Jun 1972).

The statistical fluctuations in the nuclear gap parameter are studied. The difference between the average and most probable gap parameter is discussed, and the absence of a sharp second-order phase transition is shown. (auth)

44341 PARAMETERIZATION OF THE THREE-BODY D-FUNCTION. Adhikari, S. K.; Amado, R. D. (Univ. of Pennsylvania, Philadelphia). Phys. Lett.; 40B: No. 1, 11-14(12 Jun 1972).

A new parameterization for the three-body D function is presented. It is correct in both weak coupling and the Efimov limit, and agrees remarkably well with "exact" numerical calculations for a boson model and for the neutron-deuteron system. (auth)

44342 REMARKS ON THE EXCITATION FUNCTION OF THE SCATTERING CROSS SECTION BETWEEN HEAVY IONS. Low, K. S.; Tamura, T. (Univ. of Texas, Austin). Phys. Lett.; 40B: No. 1, 32-6(12 Jun 1972).

A level density argument is made concerning the J dependence of the imaginary potential in the scattering between two heavy ions. Based on this argument, a possible explanation of the intermediate structure in excitation functions of heavy-ion scattering is also given. (auth)

44343 KINEMATICAL EFFECTS IN HEAVY-ION REACTIONS. Brink, D. M. (Oxford Univ.). Phys. Lett.; 40B: No. 1, 37-40(12 Jun 1972).

Transfer reactions between heavy ions at energies well above the Coulomb barrier have a large cross section only if certain kinematical conditions are satisfied. These relate the Q value of the reaction to the angular momentum of the transferred nucleons in the initial and final nuclei. (auth)

44344 COMPLEX EFFECTIVE INTERACTIONS IN MICROSCOPIC DESCRIPTIONS OF (τ,t) SCATTERING. Fadner, W. L. (Univ. of Colorado, Boulder); Kraushaar, J. J.; Hayakawa, S. I. Phys. Lett.; 40B: No. 1, 49-52(12 Jun 1972).

In DWBA calculations for the (^{3}He,t) reaction, an effective interaction which is complex rather than real significantly improves the shapes of angular distributions for analog ground states, and greatly reduces the J dependence of the strengths for excited states. (auth)

44345 COMMENTS ON A THREE BODY MODEL OF STRIPPING. Nagarajan, M. A. (Univ. of California, Berkeley). Phys. Lett.; 40B: No. 1, 65-6(12 Jun 1972).

The three-body model of stripping proposed by Pearson and Coz [Nucl. Phys., 82: 533(1966)] is discussed. It is shown that in a (d, p) reaction the assumption that the neutron-proton interaction does not affect the state of the proton and only provides an average potential for neutron capture leads to a prediction of vanishing of the transition amplitude. (auth)

44346 THREE-PARTICLES FINAL STATE REACTIONS. Sharaf, M. A.; Waly, M. I. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett.; 40B: No. 1, 67-9(12 Jun 1972).

The first-iteration solution of the Faddeev equations is used to evaluate the transition amplitude for (α, 2α) reactions. Reasonable approximations are adopted to calculate the off-energy shell effects. Good agreement with the experimental results is obtained. (auth)

44347 THREE-BODY TREATMENT OF (d,p) REACTIONS IN A TRUNCATED MODEL SPACE. Takeuchi, K. (Univ. of Manchester, Eng.). Phys. Lett.; 40B: No. 1, 73-6(12 Jun 1972).

In order to relate the exact 3-body theory to the distorted-wave theory based on a severely truncated model space, an attempt is made to deal with the 3-body treatment on a model space supplemented by the conceptual optical-model potential. A useful note for this purpose is that the disconnected Lippman-Schwinger integral kernels become connected after projection of them on the open and closed channels other than 3-body break-up channels. It is seen that the amended Dodd-Greider's approach gives us the justification of the DWBA calculation. (auth)

44348 MICROSCOPIC FORM FACTORS FOR CHARGE EXCHANGE REACTIONS TO UNBOUND RESIDUAL STATES. Coker, W. R.; Hoffmann, G. W. (Univ. of Texas, Austin). Contract AT (40-1)-2972. Phys. Lett.; 40B: No. 1, 81-3(12 Jun 1972).

It is shown that, although final nuclear states populated in charge-exchange reactions on most nuclei with A > 60 are proton unbound, there is at most a 10% enhancement of the microscopic charge-exchange form factor when the decay of the final state is taken into account. (auth)

44349 THEORY OF ANHARMONIC COLLECTIVE OSCILLATIONS. Ferreira, Lidia S.; Caldeira, Maria Helena (Univ., Coimbra). Nucl. Phys.; A189: No. 2, 250-6(1972).

An expression for the anharmonic collective Hamiltonian containing a variable inertia coefficient is derived, on the basis of the generator-coordinate method and the Gaussian overlap approximation. The anharmonic model obtained is tested with Lipkin's model. A classical discussion of anharmonic oscillations based on the time-dependent variational principle is also presented and compared with the quantal description. (1 table) (auth)

44350 SEPARATION APPROXIMATION IN THE CONTINUUM SHELL MODEL AND APPLICATION TO THE GIANT RESONANCE OF ^{12}C. Birkholz, J. (Technische Hochschule, Darmstadt, Ger.). Nucl. Phys.; A189: No. 2, 385-402(1972).

An approximation scheme for treating the coupled-channel equations in the continuum shell model is presented. The method is based on an expansion of the single-particle continuum functions in terms of a discrete set of basis states in the region of strong nuclear interactions. This approach is applied to the description of the photonuclear giant resonance of ^{12}C. The giant dipole states of this nucleus are described by coupling a 2s or 1d particle to the low-lying normal-parity states of the residual nuclei ^{11}B and ^{11}C. The ground state of ^{12}C and the states of the residual mass-11 nuclei are taken from a 1p-shell intermediate-coupling calculation. The results are compared with the predictions of the simple 1p–1h model and with experimental data. (9 figures, 2 tables) (auth)

44351 K-MATRIX FORMALISM FOR OVERLAPPING RESONANCES. Aitchison, I. J. R. (Oxford Univ.). Nucl. Phys.; A189: No. 2, 417-23(1972).

The relation between the potential-theory and S-matrix approaches to the overlapping resonance problem is derived in an elementary way by relating both to the K-matrix approach. A generalization of the formalism to the production of overlapping resonances in final states is given. (2 figures) (auth)

44352 MANUAL OF THE CODE FOR COMPUTATION OF THE FORM FACTOR OF TWO-NUCLEON TRANSFER REACTION. Yamaji, Syuhei (Inst. of Physical and Chemical Research, Wako, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 65: No. 3-4, 79-94(Dec 1971).

This report is a manual of the code for computing the form factor of the two-nucleon-transfer reaction, which is useful in the study of nuclear spectroscopy in nuclear physics. Preparations of the input data cards are explained in detail. (auth) (Japan)

44353 PROTON INDUCED COHERENT PRODUCTION OF PARTICLES IN NUCLEI. Lesniak, H.; Lesniak, L. (Inst. of Nuclear Physics, Krakow). Phys. Lett.; 40B: No. 2, 167-70 (26 Jun 1972).

Energy dependence of the three-prong production cross-section induced by high-energy protons in nuclei is studied. The nuclear emulsion results are in agreement with predictions of the optical model. (auth)

44354 SOFT MULTIPOLE RADIATION AND CHARGE-CURRENT DISTRIBUTION IN A NUCLEUS. Bosco, B. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence). Phys. Lett.; 40B: No. 2, 171-3(26 Jun 1972).

The conditions that a vector field vanish outside a given radius are applied to the emitted radiation. It is shown that the determination of the multipole radiation with polarization allows a determination of the curl and divergence of radiating current. (auth)

44355 NOVEL APPROACH TO THE EVAPORATION OF COMPLEX FRAGMENTS. Moretto, L. G. (Univ. of California, Berkeley). Phys. Lett.; 40B: No. 2, 185-8(26 Jun 1972).

The formalisms describing the evaporation of complex fragments on the basis of the final state phase space are shown to be seriously inaccurate. The relevance of shape polarization is discussed and new expressions for the decay widths and the kinetic energy distributions are derived. (auth)

44356 ISO-SPIN CENTROIDS FOR SINGLE-NUCLEON TRANSFER REACTIONS INVOLVING MULTI-SHELL TARGET STATES. Bansal, R. K. (Panjab Univ., Chandigarh, India). Phys. Lett.; 40B: No. 2, 189-91(26 Jun 1972).

In single nucleon transfer reactions involving multi-shell targets, equations relating the isospin centroid (defined as J-averages of the energy weighted strengths) to the nature of the residual interaction and to the quantum numbers of the target state have been derived. Test-applications of the derived equations have also been presented. (auth)

44357 ELECTROEXCITATION AND ELECTRODISINTEGRATION OF DOUBLY EVEN NUCLEI VIA THE 1p-1h CONTINUUM. Antony-Spies, Peter (Univ., Frankfurt am Main). Nucl. Phys.; A188: No. 3, 641-65(1972).

The problem of the nuclear continuum is treated in the framework of the eigenchannel theory of nuclear reactions using 1p-1h states. The treatment of electron scattering is restricted to the plane-wave Born approximation. On this basis, formulas are derived for electroexcitation form factors and cross sections as well as for electron-nucleon angular correlations. Numerical results are presented for the 1^-, 2^-, 3^- and 4^- states of ^{12}C in the energy range from the proton emission threshold at 16 MeV up to 30 MeV. (auth)

44358 BATEMAN METHOD AND ALGEBRAIC SOLUTION OF THE THREE-NUCLEON INTEGRAL EQUATIONS. Kharchenko, V. F. (Inst. for Theoretical Physics, Kiev); Storozhenko, S. A.; Kuzmichev, V. E. Nucl. Phys.; A188: No. 3, 609-31(1972).

By using a separable expansion for the two-particle t-matrix the problem of three particles with pair interaction is reduced to a set of one-dimensional integral equations. By a subsequent separable representation of the kernels of such integral equations (based on the Bateman method) the three-body problem is reduced to the solution of algebraic equations. Results are presented for the three-particle binding energies and scattering length in the case of identical zero-spin particles and for the triton binding energy and n-d scattering lengths. Comparisons are made between two separable approximations for the two-particle t-matrix, namely, between the unitary pole approximation and the Hilbert–Schmidt one. (auth)

44359 GENERATING FUNCTION METHOD AND DEVELOPMENTS IN QUASIBOSONS. Hage-Hassan, M.; Lambert, M. (Univ. Claude Bernard, Lyon). Nucl. Phys.; A188: No. 3, 545-65(1972). (In French).

An isomorphism between the H′ subspace of the physical bound states and a normalized F functional space is established. This is done by introducing a generating function for these H′ states. By choosing for the F-space the Bargmann's space, an isomorphism is obtained between an H_F space of the fermion states and an H_B space of the boson states. An expansion of any quasiboson operator of H_B is thus feasible. This is particularly interesting for the Hamiltonian operator. In this case the expansion obtained, similar to the Beliaev–Zelevinski and Marumori expansions, appear to be simple and more convergent. (auth)

44360 CONTINUUM EFFECTS IN STRUTINSKY CALCULATIONS. Ross, C. K.; Bhaduri, R. K. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; A188: No. 3, 566-76(1972).

In calculating shell corrections to nuclear binding energies by the Strutinsky method using finite potential wells, large ambiguities are encountered if the continuum effects are entirely ignored. It is argued qualitatively that the modifications to the continuum level density brought about by the potential should play an important role in the Strutinsky method. Quantitative calculations in two specific cases confirm that reasonably unique values for shell corrections are obtained by the inclusion of such effects. (auth)

44361 COMPARISON OF OPTICAL-MODEL AND CONTINUUM SHELL-MODEL RESULTS FOR THE s-WAVE NEUTRON STRENGTH FUNCTION. Schaefer, L. (Univ., Heidelberg). Nucl. Phys.; A188: No. 3, 577-99(1972).

Using simple assumptions about the energy dependence of the matrix elements it is shown that the continuum shell-model at low energies leads to the same form of the averaged S-matrix as the phenomenological optical model. Both models give nearly the same averaged resonance parameters. Differences can be traced back to unphysical assumptions of the optical model. It is found that the resonance width is bounded and that the average resonance width takes its biggest value at some finite strength of the residual interaction. In the presence of a virtual single-particle state the resonance parameters exhibit a strong maximum (no cusp) as function of energy and nucleon number. It is found that in comparing experimental data with the predictions of the optical model one should always use the resonance width and not the residue. (auth)

44362 VALIDITY OF THE PSEUDO SU(3) FOR A equals 59 AND 60. Strottman, D. (Oxford Univ.). Nucl. Phys.; A188: No. 3, 488-512(1972).

The validity of the pseudo-coupling scheme introduced by Arima et al., is examined for three and four nucleons outside a closed ^{56}Ni core using both an effective and a realistic interaction. Moments of distributions are used to examine truncation schemes based on pseudo SU(3). It is found that pseudo SU(4) fails to provide an adequate description, but pseudo SU(3) is reasonably good for low-T states. (auth)

44363 CLUSTER DESCRIPTION USING SUPERMULTIPLET SCHEME. Deenen, J. (Univ., Brussels). Nucl. Phys.; A189: No. 1, 73-82(1972).

Second quantization and group theory are used to describe the cluster structure of light nuclei. Theoretical calculations are presented in more detail for a two-centered model and applied to ^{5}He and ^{6}Li. (auth)

44364 ANOMALOUS NODES IN THE BOUND STATE WAVE FUNCTIONS FOR NON-LOCAL POTENTIALS. Hooverman, R. H. (Union Coll., Schenectady, N. Y.). Nucl. Phys.; A189: No. 1, 161-9(1972).

A numerical study of bound-state solutions of the Schroedinger equation with non-local potentials has revealed an unexpected property of such wave functions: If the kernel of the potential operator has a positive sign and if the non-locality is sufficiently large, the wave functions will have more nodes than do those of local potentials. (auth)

44365 TECHNIQUE FOR NUMERICAL SOLUTION OF THE SCHROEDINGER EQUATION WITH NON-LOCAL POTENTIALS. Hooverman, R. H. (Union Coll., Schenectady, N. Y.). Nucl. Phys.; A189: No. 1, 155-60(1972).

In the general case in which the potential is non-local, bound-state solutions to the time-independent Schroedinger equation can be obtained numerically by approximating the integro-differential equation by a matrix equation. (auth)

44366 TWO-NEUTRON TRANSFER REACTIONS ON RARE-EARTH NUCLEI. Takemasa, T.; Sakagami, M.; Sano, M. (Osaka Univ.). Phys. Rev. Lett.; 29: No. 2, 133-6(10 Jul 1972).

The angular-momentum projection method is applied to the description of (t,p) and (p,t) reactions on deformed nuclei. The difference between the deformations of a target nucleus and that of a residual nucleus is taken into account in the calculation of the spectroscopic amplitude. The calculation is especially focused on the ground-state to ground-state (p,t) transitions. The neutron-number dependence of the calculated distorted-wave Born-approximation cross sections is in good agreement with the experimental results. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

44367 PLASMA PHYSICS INDEX. VOLUME 7, NO. 5, 1972. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 199p.

This listing contains 567 references on various aspects of plasma physics. (M.O.W.)

Confinement and Heating

Refer also to abstracts 44378 and 45051.

44368 (SFTI–1) EFFECT OF THE NONHOMOGENEITY OF A MAGNETIC FIELD ON THE HEATING OF PLASMA BY AN ELECTRON BEAM IN A MIRROR TRAP. Demirkhanov, R. A.; Gevorkov, A. K.; Popov, A. F.; Kolmakov, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Sukhumi. Fiziko-Tekhnicheskii Institut). 1972. 30p. (In Russian). Dep. NTIS (U. S. Sales Only).

The effect of the inhomogeneity of a magnetic field on plasma heating by an electron beam in a magnetic trap of the probkotron type was experimentally investigated. The possibility of an effective linear absorption of the oscillation energy excited by the beam in the plasma in a nonhomogeneous field was demonstrated. The experimental data confirmed the mechanism of stochastic cyclotron heating of the electron component of the plasma in a mirror trap. The effectiveness of heating was maximized when the spectrum of the oscillations excited in the plasma lay in the region of cyclotron frequencies of the probkotron. (tr-auth)

44369 TURBULENT HEATING OF ELECTRONS AND IONS IN A COLLISIONLESS SHOCK WAVE. Demchenko, V. V.; Hussein, A. M. (Atomic Energy Establishment, Cairo). Phys. Lett.; 40A: No. 2, 129-31(3 Jul 1972).

Turbulent heating of a nonisothermal plasma by a collisionless shock wave is analyzed in the situation when a small-scale high-frequency instability occurs at the wave front. Effective time of electron and ion heating is estimated. (auth)

44370 ION HEATING VIA TURBULENT ION ACOUSTIC WAVES. Taylor, R. J.; Coroniti, F. V. (Univ. of California, Los Angeles). Phys. Rev. Lett.; 29: No. 1, 34-8(3 Jul 1972).

Three-dimensional ion-acoustic turbulence is excited by injecting a cold ion beam into a nonmagnetized plasma with $T_e/T_i > 5$. A rapid, approximately exponential heating of the ion beam is observed along the beam path. The heating rates level off when the ion temperature approaches $0.2T_e$. The turbulent ion-acoustic wave energy density does not exceed $(1 \text{ to } 3) \times 10^{-3}T_e$. Wave saturation, which occurs before significant dissipation of ion beam energy, is consistent with orbit-diffusion strong-turbulence theory. (auth)

44371 PLASMA BUILD-UP IN A MAGNETIC WELL BY BEAMS OF NEUTRAL ATOMS AT DIFFERENT ENERGIES, INJECTED AT DIFFERENT ANGLES. Dei-Cas, R.; Hennion, F. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 14: No. 3, 253-67(Mar 1972). (In French).

Numerical calculations of the plasma build up in an open magnetic well with ten neutral beams at different energies, injecting at different angles are presented. The model allows one to follow the spatial and temporal evolutions of the density, anisotropy, and energy distribution and also the spatial and temporal evolutions of the neutral gas density. The proposed injection method allows control of the initial conditions (energy spectrum, anisotropy) in a large domain; the produced plasma presents an anisotropy of the order of ten times lower than in present injection experiments and should be theoretically stable with respect to anisotropy and drift loss-cone instabilities. The influence of the wall desorption coefficient under fast particle bombardment on the plasma build up and on the density gradient is described. (auth)

44372 OFF-RESONANCE HEATING OF MIRROR CONFINED PLASMAS. Sprott, J. C.; Connor, K. A.; Shohet, J. L. (Univ. of Wisconsin, Madison). Plasma Phys.; 14: No. 3, 269-74 (Mar 1972).

Experiments are described in which microwave power above or below the electron–cyclotron frequency is applied to mirror-confined plasmas. Above resonance, a finite heating rate is measured; below resonance, the plasmas are expelled. The upper off-resonance heating rate and the lower off-resonance power required to expel the plasma agree with the predictions of a proposed theoretical model in which the spatial variation of the microwave electric field of the multimode cavity randomizes the electron motion. (auth)

44373 AXISYMMETRIC MAGNETIC PUMPING FOR TOKAMAK HEATING. Koechlin, F.; Samain, A. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 14: No. 3, 349-51(Mar 1972).

Two methods of heating a plasma by low-frequency magnetic pumping are analyzed: a resonant process involving a Landau effect, where the particle mean free path is longer than the wavelength of the perturbing force; and a fluid process, where the plasma receives energy by collisional relaxation. A value for the heating power is derived. (UK)

44374 STEADY-STATE, HIGH-BETA, HOT-ELECTRON PLASMAS. Guest, G. (Oak Ridge National Lab., Tenn.). Comments Plasma Phys. Controlled Fusion; 1: No. 1, 29-32(1972).

The basic technique of resonant microwave heating of electrons is described. Instability losses during microwave heating are discussed. (M.O.W.)

Diagnostics

44375 (SC-CR-723145) EXPERIMENTAL STUDIES OF FLUSH-MOUNTED ELECTROSTATIC PROBES IN COLLISION-DOMINATED HYPERSONIC IONIZED FLOWS. Boyer, Donald W. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). Jul 1972. 65p. Dep. NTIS.

For Sandia Labs., Albuquerque, N. Mex.

An experimental investigation was made of ion-current collection by flush-mounted electrostatic probes on a sharp flat plate in ionized hypersonic flows. The effects of probe size, geometry, position, bias potential and local flow properties were investigated under conditions of a collision-dominated sheath. The probe current densities measured in nitrogen, argon, and carbon monoxide plasmas were correlated in terms of the ion convective flux, flow Reynolds number, probe size and bias potential. (auth)

44376 DETERMINATION OF PLASMA POTENTIAL. Asvadurov, K. D.; Vasil'eva, I. A.; Torchinskii, V. M. (Inst. of High Temperatures, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 166-7(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 207-8(Jan 1972).

The well-known method of determining the space potential from the maximum in the amplitude of the low-frequency plasma noise in the probe circuit in measuring the electron energy distribution function is not always independent of the method used to determine the plasma potential from the probe characteristic. The delay in the buildup of the space charge, and the displacement currents in the sheath at the probe can contribute to the ac signal at high frequencies. With no magnetic field and no electron collisions in the sheath, these frequencies are close to the plasma frequency at negative probe potentials. The transmission of signals at much lower frequencies leads to differentiation of the probe characteristics. In magnetic fields and with collisions in the sheath, the frequency at which the reactive current becomes important is reduced. (auth)

44377 SPECTRAL ANALYSIS OF BACKSCATTERED LIGHT FROM LASER-PRODUCED PLASMA: REEXAMINED. Belland, P.; DeMichelis, C.; Mattioli, M.; Papoular, R. (CEN, Fontenay-aux-Roses, France). Appl. Phys. Lett.; 21: No. 1, 32-3(1 Jul 1972).

Previous measurements on the backscattered light from a laser-produced plasma, showing a line structure, have been incorrectly interpreted. New experiments reveal a shift of the backscattered light together with considerable broadening. (auth)

44378 MICROWAVE INVESTIGATION OF PLASMA TRAPPED IN THE INJECTOR–DIVERTOR DEVICE OF A STELLARATOR. Atamanov, N. S.; Zalkind, V. M.; Zykov, V. G.; (and others) (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1456-61(Sep 1971). (In Russian).

A radial density profile was studied in plasma trapped in the injector–divertor device of a stellarator. The measurements were made by the method of phase location and microwave interferometer with a moving horn. It is shown that, when the plasma is injected through the magnetic slit of the device, the trapped plasma density is several times higher than when the plasma is trapped by tangential injection into the magnetic field. (auth)

44379 THEORY OF THE QUADRUPOLE PROBE IN A HOT ISOTROPIC PLASMA. Rooy, B.; Feix, M. R.; Storey, L. R. O. (CNRS, Saint-Maur-des-Fosses, France). Plasma Phys.; 14: No. 3, 275-300(Mar 1972). (In French).

The theory of the quadrupole plasma probe predicts certain singularities (resonances, anti-resonances) in the transfer impedance of the quadrupole. From the form of the frequency response curve (in particular, from the position and height of the resonance peak) one can, in principle, determine the various plasma parameters (in particular, the electron density and temperature). The theory is developed for a collisionless isotropic plasma. The motion of the ions is neglected. The distribution function of the velocities of the electrons is assumed to be Maxwellian. It is then possible to calculate the transfer impedance of the quadrupole probe analytically. The main results are that the impedance at the resonance depends in a simple way on the electron temperature and that the quadrupole probe is interesting as a possible means of measuring the electron temperature of a plasma. (UK)

44380 OPTICAL TRANSITIONS STIMULATED BY PLASMA TURBULENCE. Bekefi, G. (Massachusetts Inst. of Tech., Cambridge). Comments Plasma Phys. Controlled Fusion; 1: No. 1, 9-16(1972).

Stark splitting of energy levels of a turbulent plasma is discussed. Experimental and theoretical data of Stark splitting are reviewed. (M.O.W.)

44381 USE OF A LASER WITH TUNABLE FREQUENCIES OF RADIATION FOR THE DETERMINATION OF THE ABSORPTIVE PROPERTIES OF A PLASMA. Burakov, V. S.; Naumenkov, P. A.; Kolosovskii, G. A. Zh. Prikl. Spektrosk.; 16: No. 1, 54-7 (Jan 1972). (In Russian).

The absorption coefficients of a plasma were measured for certain wavelengths in the range 460 to 700 nm. The plasma of an electric discharge in a 2.9-mm-diameter textolite capillary was investigated for a discharge current of 7,500 A and a pulse duration of 400 μsec. At a temperature of 4×10^4°K, the plasma became translucent for the laser radiation on solutions of organic compounds. The continuous absorption coefficients of the plasma were 2 to 5.5 cm^{-1} under conditions of the discharge selected. (tr-auth)

44382 DIAGNOSTICS TECHNIQUES FOR THE 2XII AND BASEBALL II MIRROR EXPERIMENTS. Cummins, W. F. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 731-5(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A brief sketch is given of the various types of equipment and their mode of operation. These techniques include neutral-particle analyzers, interferometers, neutral-beam probing, and laser scattering. Various other techniques are also outlined. (M.O.W.)

44383 ELECTRON CYCLOTRON RADIATION MEASUREMENTS TO DETERMINE RELATIVE ELECTRON TEMPERATURES IN A LOW-DENSITY MAGNETIC-MIRROR PLASMA SYSTEM. Gardner, Andrew L. (Brigham Young Univ., Provo, Utah) IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 757-60(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Measurements of the electron cyclotron radiation emitted from the plasma of the Alice system were made using a synchronous detection microwave radiometer in the range of 10.2 to 11.6 GHz. Both sidebands were used to sample radiation from two nested closed shells within the plasma. For a tenuous plasma this radiation is proportional to the product of the electron density and the electron temperature. Since measurements of the plasma density were available from other detectors, relative values of the electron temperature were obtained using the measured radiation intensity. (auth)

44384 PULSED SUBMILLIMETER INTERFEROMETER FOR TRASIENT PLASMA DIAGNOSTICS. Throop, Alan L. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 761-9(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The application of a far-infrared interferometer to transient plasma diagnostics is described. The experimental performance of the interferometer under varying plasma conditions is presented. Detailed discussion is devoted to such important system parameters as observable density range, spatial resolution, time response, calibration techniques, and gamma radiation effects. (auth)

44385 1.5-MHz, DIGITAL, PLASMA-DATA ACQUISITION AND PROCESSING SYSTEM USING MULTI-TIME-DELAY SAMPLING. Smith, D. E.; Thomas, C. W.; Powers, E. J. (Univ. of Texas, Austin). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 784-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A "multi-time-delay sampling" technique is described in which the effective sampling rate is increased while the sampling rate of the digitizer is held fixed. The technique was utilized to extend the analysis bandwidth of an analog–digital, plasma data acquisition and processing system to 1.5 MHz. Such an enhancement in bandwidth capability is extremely valuable in analyzing phenomena associated with turbulent plasmas. Results are presented using known waveforms and actual plasma data in order to demonstrate the extended bandwidth capability provided by this technique. (auth)

44386 EFFECT OF PLASMA RESISTANCE ON ELECTRON TEMPERATURE MEASUREMENT BY MEANS OF AN ELECTROSTATIC PROBE. Matsumura, S.; Chen, Sin-li (Musashi Inst. of Tech., Tokyo). J. Appl. Phys.; 43: No. 8, 3357-61(Aug 1972).

The effect of the equivalent plasma resistance between the probe and the reference electrode on the gradient of the semilog plot of the electron-current curve vs. voltage of a probe was studied theoretically for probes of plane, cylindrical, and spherical types. The probe current–voltage characteristic actually measured deviates from its regular curve because of drawing current through the bulk plasma not having an infinite conductivity. The electron temperature T_e determined from the measured electron-current curve by using the usual graphical method will be higher than its true value. The theoretical maximum errors in T_e determination for the three kinds of probe studied are all within a factor of 2. Some experiments are also presented and discussed. (auth)

44387 FIXED-BIAS FLOATING DOUBLE-PROBE TECHNIQUE WITH SIMPLE LANGMUIR-PROBE CHARACTERISTICS. Szuszczewicz, Edward P. (Goddard Space Flight Center, Greenbelt, Md.). J. Appl. Phys.; 43: No. 8, 3328-35(Aug 1972).

The new floating double-probe method has advantages over other floated-probe systems heretofore described in the literature. The method utilizes two electrodes, one of constant area and the other with a variable area, and the two-electrode configuration is separated by a fixed bias voltage. The current–voltage characteristics of the new technique, generated by varying the area of one electrode, are identical to those of a simple Langmuir probe, thus coupling all the advantages of a floated-probe system with the simple analysis scheme generally applied to the Langmuir probe for the determination of plasma density and temperature. (auth)

Kinetics (General)

44388 (BMBW-FBK-72-5) INVESTIGATION OF STRONG SHOCK WAVES, PRODUCED IN A DIAPHRAGM SHOCK TUBE. Meinhold, G. (Kiel Univ. (West Germany). Institut fuer Experimentalphysik). May 1972. 95p. (In German). Dep. NTIS (U. S. Sales Only).

An investigation was performed using 70-GHz microwaves on shock-heated monatomic gases (Ar, Kr). The shock wave generates a nonequilibrium plasma. Information about the ionization mechanism is obtained by electron-density measurements. In the electron-density range under investigation, the ionization rates are controlled by atom–atom collisions only. The increase of electron temperature with time was measured with sufficient accuracy. (auth)

44389 (LRP–41/72) INFLUENCE OF LIMITERS ON THE PENETRATION OF AN OSCILLATING AXIAL CURRENT IN A STRAIGHT DISCHARGE. Jones, I. R.; Peiry, J.-M.; Troyon, F. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Apr 1972. 20p. Dep. NTIS (U. S. Sales Only).

Schemes of dynamic stabilization of pinches that rely on oscillating magnetic fields transverse to the main static field encounter severe difficulties caused by the screening of the field by residual plasma. It is shown that insulating limiters, regularly placed along a column, suppress the screening effect by exciting stationary Alfvén waves, and allow the axial oscillating current to flow on the central plasma core. (auth)

44390 HIGH-FREQUENCY DISCHARGE IN A COAXIAL RESONATOR WITH AN EXTERNAL MAGNETIC FIELD. Ivanov, G. A.; Gavrilova, Z. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 53-8(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 71-8(Jan 1972).

A high-frequency resonance discharge and a high-frequency single-electrode discharge are considered in a coaxial resonator in a longitudinal magnetic field. Experiments that confirm the theory are described. Under certain conditions the losses due to the high-frequency single-electrode discharge are large, being governed mainly by the secondary-emission coefficient of the electrode material and by the ratio of the frequencies $\omega = \omega_0 = eH/mc$. (auth)

44391 NEW THEORY OF BALL LIGHTNING. Zaitsev, A. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 173-5(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 213-16(Jan 1972).

On the basis of published work on the structure of small conducting particles in electric fields it is proposed that such structures, together with the coronal space charge in the constant earth—cloud electric field, form a seed for linear lightning. The current of the preleader stages of the discharge from the seed, flowing through the structure, heats it to a visible glow. The current of the leader through the structures drives it to thermal explosion. The seed of the linear lightning is taken by the casual observer to be ball lightning. The conditions necessary for the production of the structure are described. The properties of ball lightning are predicted on the basis of the present explanation. (auth)

44392 PRODUCTION OF LARGE AREA HIGH CURRENT ION BEAMS. Okamoto, Yukio; Tamagawa, Hajime (Nagoya Univ., Japan). Rev. Sci. Instrum.; 43: No. 8, 1193-7(Aug 1972).

A newly designed microwave ion source has produced a hydrogen ion beam up to 0.5 A in steady-state operation with an ion energy of 1 keV. The 4-cm-diam extraction electrodes are multiple apertures and are arranged in an accel—decel arrangement. Maximum divergence is 2° from the beam axis. The beam is 85% molecular ions, of which either the diatomic or triatomic component can be maximized by an adjustment of the gas fed to a discharge region. The source is technologically simple, inexpensive, and long-lived. The basic concepts underlying the production of ion beams are described. (auth)

44393 EMISSION OF COHERENT MICROWAVE RADIATION FROM A RELATIVISTIC ELECTRON BEAM PROPAGATING IN A SPATIALLY MODULATED FIELD. Friedman, M.; Herndon, M. (Naval Research Lab., Washington, D. C.). Phys. Rev. Lett.; 29: No. 1, 55-8(3 Jul 1972).

Observations of the rf emission from the interaction of a relativistic electron beam with a modulated magnetic field have led to a qualitative theory. This theory predicts emission of high-power radiation at high-frequency harmonics. An improved experiment has confirmed these predictions. (auth)

44394 STUDY OF PLASMA ACCELERATION BY A MAGNETIC PISTON. Miida, Yoshiro (Chiba Inst. of Tech., Narashino, Japan). Chiba Kogyo Daigaku Kenkyu Hokoku; No. 16, 30-6(Mar 1971). (In Japanese).

It was observed that a plasma was accelerated with a magnetic piston that traveled along an electric delay line. The plasma was produced in a conical discharge tube with two electrodes. The plasma velocity was measured with a streak camera and a photomultiplier. The results of the experiment qualitatively agreed with MHD theory. (auth) (Japan)

44395 PHENOMENOLOGICAL STUDY OF THE STEADY-STATE CURRENT SHEET SPEED IN A MAGNETICALLY DRIVEN SHOCK TUBE. Chang, C. T. (Danish Atomic Energy Commission Research Establishment, Risoe). Z. Naturforsch.; 27b: No. 6, 948-55(Jun 1972).

The discrepancy between the measured steady-state speed of the current sheet and the theoretically predicted value is examined through a detailed analytical and experimental study of the basic assumptions used in the model. It is found phenomenologically that the observed deviation at discharge conditions of low voltage and high pressure could be attributed mainly to the spreading of the current-carrying region in time. The deviation occurring at discharge conditions of high voltage and low pressure could be attributed to the possible presence of an ion drag caused by the interaction between the plasma and the electrode surface. (auth)

44396 INVESTIGATION OF NONEQUILIBRIUM EFFECTS IN AN ARGON FREE-JET PLASMA. Cassady, Philip E. (Lockheed Research Labs., Palo Alto Calif.); Lees, Lester. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 10: No. 7, 855-6(Jul 1972).

Nonequilibrium effects present in the formation of a shock wave in a low-density, slightly ionized flow, particularly as evidenced by the appearance of a dark region preceding the shock wave, were analyzed both theoretically and experimentally. A theoretical model for the shock wave predicted a precursor region of high electron temperature. An experimental investigation was performed in an arc-heated free-jet flowfield. Electron temperature and ion density were measured through the normal shock wave in front of a cooled blunt body, using a new type of cooled Langmuir probe. The existence of a precursor region of elevated electron temperature, coincident with the observed dark region, was experimentally verified. (auth)

Kinetics (Experimental)

44397 INDUCED RADIATION IN THE PINCH DISCHARGE. Sutovskii, V. M. Tr. Fiz. Inst., Akad Nauk SSSR; 56: 66-118 (1971). (In Russian).

Radiation was induced in a direct pinch discharge for the ions Ar II and Ar III in the visible and ultraviolet regions of the spectrum, and was investigated at various geometries and energy parameters. The discharge current, the accompanying voltage drop, the distribution of current with respect to the cross section of the chamber, and the rate of development of the discharge were also subjects of study. The temperature and plasma density at the moment of cumulation were measured spectroscopically. The conductivity of the plasma was an indication of the electron temperature. Possible mechanisms of this excitation and its prospects in the vacuum-ultraviolet realm are discussed. The primary advantage of the pinch discharge was the large rate of electron contribution at the moment of cumulation, resulting from a rapid transfer of energy to the electron component from the ionic component, which is heated by the energy of compression of the discharge. (tr-auth)

44398 BEAM–PLASMA INTERACTION IN RELATIVELY SHORT EXPERIMENTAL SYSTEMS. Jungwirth, K.; Piffl, V.; Ullschmied, J. (Inst. of Plasma Physics, Prague). Plasma Phys.; 14: No. 3, 339-47(Mar 1972).

In a short system, the amplitude of the excited wave with the group velocity comparable to that of the beam grows to a measurable value only if conditions for multiple reflections are provided. In this case, the effectiveness of the interaction is further lowered by the systematic change of the phase velocity of the excited wave, leading to the interruption of the instability after a few such reflections. The theoretical results were confirmed by the experimental measurements on the ELMAN II machine. (UK)

Kinetics (Theoretical)

44399 (COO–3086-14) COMPUTER SIMULATION OF SLIGHTLY COLLISIONAL PLASMAS. Gula, William Peter (Columbia Univ., New York). 1972. Contract AT(11-1)-3086. 152p. Dep. NTIS.

The resistivity of a two-dimensional particle-in-cell computer plasma under the influence of a steady applied electric field was studied in order to gain information about the collisional processes of such a plasma model. It was found that before the plasma goes unstable there are two distinct periods of development. At first, before electron heating occurs, the system sets up a field that weakens the applied field but does not cancel it; then, a period of linear electron temperature growth occurs. To study the effects of collisions in a plasma, a computer code was developed that incorporated collisional effects directly by using the effects of the Krook model collision operator in the kinetic equation. This code was used to investigate electron—electron collisional effects on the two-stream instability. (auth)

44400 (ORNL-TM-3821) ANGULAR DISTRIBUTION OF BREMSSTRAHLUNG FROM MIRROR-CONFINED ELECTRONS. England, A. C.; Haste, G. R. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 34p. Dep. NTIS.

The bremsstrahlung radiation from electron—ion collisions is emitted anisotropically in directions dependent on the electron kinetic energy and the photon energy. The radiation from electrons confined in magnetic mirrors is considered here. In particular, the magnitude of this anisotropy is examined as a function of the electron energy, the photon energy, the electron pitch angle, and the angle of a detector with respect to the magnetic-mirror midplane. The calculations are performed in the Born approximation with the cross sections developed by Gluckstern and Hull. The temperature of a bi-Maxwellian distribution is calculated from the slope of the log intensity vs. photon energy curve. The effects of pitch-angle distribution and detector angle on the anisotropy of the radiation are considered. (auth)

44401 DIELECTRIC RESPONSE FUNCTION FOR AN ANISOTROPIC PLASMA. Imamuddin, M.; Saxena, V. K.; DeKeyser, R. (Univ. of Leuven, Belgium). Phys. Lett.; 40A: No. 2, 122(3 Jul 1972).

It is demonstrated how approximations may be obtained for the longitudinal dielectric response function of the anisotropic plasma of Joyce and Montgomery (Phys. Fluids, 10: 2017(1967)) by the simple additivity principle for the susceptibility and by a Galilean transformation of the Lindhard expression (Dan. Vid. Selk., Mat.-Fys. Medd., 28, No. 8(1954)). (auth)

44402 ACCESSIBILITY OF EXACT NONLINEAR STATIONARY STATES IN WATER-BAG MODEL COMPUTER EXPERI-

MENTS. Finzi, U. (CEN, Grenoble, France). Plasma Phys.; 14: No. 3, 327-37(Mar 1972).

The Bernstein, Greene, and Kruskal stationary states of a four contours water-bag system are discussed in detail. The time evolution of a linearly stable two-stream system towards an exact nonlinear stationary state is shown to take place in computer experiments, when suitable initial conditions are adopted. As a by-product a method for the excitation of pure modes in a uniform water-bag system is presented. (auth)

44403 INTEGRAL EQUATION FOR THE PAIRED CORRELATION FUNCTION OF DENSE GASES AND A PLASMA. Klimontovich, Yu. L. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.): 15: No. 8, 351-3(20 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 8, 495-7(20 Apr 1972).

Other integral equations are proposed for the correlation functions of dense gases and a plasma. The equilibrium equation for the paired distribution function is represented in the form $f_2(r_1, r_2) = e^{-(\phi_{12}/kT)}\, F(r_1, r_2)$; $(1/V^2) \int f_2 dr_1 dr_2 = 1$. The function

$$F = \frac{V^2}{Z} \int \exp\left[-\frac{\sum_{3 \leq i \leq N} (\phi_{1i} + \phi_{2i}) + \sum_{3 \leq i < i \leq w} \phi_{ij}}{kT}\right] dr_3 \ldots dr_N$$

is introduced, where Z is the statistical integral and V is the volume. The function F − 1 is represented in the form of a series in the correlation functions with increasing powers of the density. The series should have a structure such that the expression for f_2 would coincide with the corresponding virial expansion in the density when the function g_2 is replaced by its value in the zeroth approximation in the density ($g_2^0 = \exp(-\phi_{12}/kT) - 1$). (M.O.W.)

44404 RESULTS OF A COMPUTER SIMULATION OF AN ARC PLASMA IN A CURVED DISCHARGE TUBE. Wynands, Alexander (Technische Hochschule, Aachen). Z. Phys.; 253: No. 2, 134-46(1972).

Numerical calculations are made of an arc plasma in a curved geometry. In particular, the effect of the curvature on thermal, magnetic, electric, and dynamic quantities in a wall-stabilized electric arc at atmospheric pressure is discussed. (auth)

44405 COLLISIONAL–RADIATIVE VOLUME RECOMBINATION AND IONIZATION COEFFICIENTS FOR He^+–He^{2+}–e PLASMAS. Drawin, H. W.; Emard, F. (CEN, Fontenay-aux-Roses, France). Z. Phys.; 253: No. 2, 100-12(1972).

Coefficients are calculated for collisional–radiative recombination of doubly ionized helium atoms with electrons and collisional–radiative ionization of singly into doubly ionized helium atoms due to electronic collisions and radiative absorption. Up to one hundred coupled equations have been solved which corresponds to a level system in which levels up to principal quantum number one hundred have been taken into account. The numerical results are presented in form of curves for a large number of parameters corresponding to very different experimental situations. Comparison of these values with those experimentally determined by Mosburg and by Gippius et al. is made. (auth)

44406 ELECTRIC MULTIPOLE MOMENTS OF A PLASMA SPHEROID. Levin, M. L.; Muratov, R. Z. (Radiotechnical Inst., Moscow). Dokl. Akad. Nauk SSSR; 203: No. 3, 547-9 (21 Mar 1972). (In Russian).

The description of the interaction of a plasma bundle and an electromagnetic wave during quasi-static resonance requires consideration of the possibility of the excitation of not only dipole but higher electric moments. For a homogeneous plasma spheroid (neglecting spatial dispersion), it is possible to find the spectrum of natural frequencies and remain within the framework of the quasi-static theory. The constant radiation losses of multipole oscillations are readily calculated. In the solution of the problem of diffraction by a spheroidal bundle, there remains only the quantities of the electric multipole moments of the bundle during resonance. This was accomplished by means of the quasistatic method. (K.S.W.)

44407 NEOCLASSICAL THEORY OF THE TRANSPORT PROCESS. Sagdeev, R. Z.; Galeev, A. (Academy of Sciences, Moscow). Comments Plasma Phys. Controlled Fusion; 1: No. 1, 23-8(1972).

The main results of neoclassical theory for particle motion in magnetic traps are discussed. The limitations of the theory are described. (M.O.W.)

44408 TWO-SCALE PLASMA KINETIC EQUATION. Kleinsmith, Paul Elwyn. Pittsburgh; Carnegie-Mellon Univ. (1971). 102p. University Microfilms Order No. 72-17,879.

Thesis.

A modified form of the Bogolyubov plasma cluster expansion is used to derive, from the BBGKY hierarchy, an integro–differential equation for the two-particle correlation function. The exact equilibrium solution of this equation is obtained and compared to the equilibrium results of Mayer and Debye–Hückel. A long-range damping effect similar to Debye–Hückel damping is observed; however, in contrast to the Debye–Hückel result, the present equilibrium correlation is found to be nonsingular at zero particle separation. The exact BBGKY results are then applied to the formulation of a divergence-free-model kinetic equation in Fokker–Planck form. This model is further simplified by means of assumptions which are consistent with the physical conditions of high-energy beam–plasma resonance. The development of plasma electrostatic waves in such a system is treated by solving this model kinetic equation as an initial value problem, utilizing a coordinate-stretching technique to eliminate secularities encountered in such solutions. In order to numerically evaluate this solution for selected values of the beam parameters, velocity-dependent Fokker–Planck coefficients must also be computed, providing at the same time an additional point of comparison with classical plasma results. As in the case of the Boltzmann-based coefficients first calculated by Landau, certain terms may be identified as dominant for small values of particle velocity, while all terms must be retained in computing values of the coefficients for large particle velocities. The dominant terms of the present theory have the same asymptotic dependence upon velocity for large values of velocity, although they differ in magnitude from the Landau results. When all terms are accounted in computing coefficients for large values of particle velocity, the present coefficients have magnitudes which differ from the Landau results by 20 to 30%. (Diss. Abstr. Int., B)

Production

44409 LARGE QUIESCENT COLLISIONLESS HIGH-FREQUENCY DISCHARGE PLASMA. Ault, Earl R.; MacKenzie, K. R. (Univ. of California, Los Angeles). Appl. Phys. Lett.; 21: No. 1, 9-10(1 Jul 1972).

200 V p–p (peak to peak) at 80 MHz applied to a plane sheet electrode of 0.0075-cm-diam parallel wires produces a reasonably uniform large-volume collisionless plasma in zero magnetic field with a density of $\sim 10^9$ ions/cm^3 in argon at 3×10^{-4} torr. The noise fluctuation level $\langle \delta n/n \rangle \simeq 2 \times 10^{-4}$. (auth)

44410 LASERS, PLASMAS, AND FUSION. Gardner, J. W. J. Inst. Nucl. Eng.; 13: No. 3, 67-73(1972).

The next few years could see the emergence of a new generation of lasers, with output power densities (continuous or pulsed) many orders of magnitude above those currently available. Such unprecedented photon fluxes could open up new vistas in fundamental research and greatly extend practical laser applications. Of direct interest to the nuclear industry are: possible laser-separation of isotopes, and laser-triggered fusion reactors. Pulse-compression techniques, developed in connection with "super-giant" pulses, could also enhance the utility of lasers in plasma diagnostics, and in probing fast chemical reactions. (auth)

44411 GROWTH OF A LOCALIZED ELECTRON CLOUD INDUCED BY A TRANSIENT RF FIELD. Moezzi, Abdolali. Philadelphia; Univ. of Pennsylvania (1971). 123p. University Microfilms Order No. 72-6205.

Thesis.

A theoretical investigation is performed on the development of an electron cloud around a single electron–ion pair and in the presence of an intense rf pulse. It is assumed that the seed electron–ion pair exists at the origin of the coordinate system located in a medium filled with neutral gas atoms. It is further assumed that an electric field of the following form is applied to the above system $E = \hat{a}_z \sin(2\pi ft)(1 - e^{-t/\tau})[U_{-1}(t) - U_{-1}(t - \tau_p)]$ where f is the frequency of the rf field, τ_p the pulse width, τ the rise time of the electric field and U_{-1} is the unit step function. The complete spatial and temporal solution for the electron density associated with the electron cloud developing around the seed electron–ion pair is obtained. (TSS) (Diss. Abstr. Int., B)

Stability

Refer also to abstracts 44581 and 44590.

44412 (N–72–15665) INSTABILITIES AND TURBULENCE IN HIGHLY IONIZED PLASMAS IN A MAGNETIC FIELD. Semiannual Status Report. Noon, J. H.; Jennings, W. C. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nov 1971. 73p. (NASA-CR-124634). NTIS.

Experimental and theoretical work was extended on the physical mechanisms of plasma turbulence and coherent instabilities. Turbulence is described in terms of parametric effects and experimental and theoretical results show that energy is transferred in both directions of the frequency spectrum. Energy transfer to higher frequencies results in turbulence acting as a safety valve against the growth of coherent, low-frequency instabilities. Energy transfer to lower frequencies results in anomalously high diffusion rates. A linear theory was applied to the drift instability in the Rensselaer HCD, and reasonable agreement between predictions and experimental results was obtained. (auth) (STAR)

44413 ONSET OF SHORT-RANGE ORDER IN A ONE-COMPONENT PLASMA. Choquard, Ph.; Sari, R. R. (Ecole Polytechnique Federale, Lausanne, Switzerland). Phys. Lett.; 40A: No. 2, 109-10(3 Jul 1972).

A self-consistent, asymptotic analysis of the H.N.C. approximation to the pair distribution function g(r) of a classical one-component plasma is presented. It is found that g(r) begins to exhibit damped oscillations at $\Gamma_c = 1.0$ where $\Gamma = (Ze)^2/\alpha K_B T$ is the parameter that characterizes the system. (auth)

44414 OBSERVATION OF SATELLITE MODES IN A BEAM–PLASMA INSTABILITY. Ohkubo, K.; Tanaka, S. (Kyoto Univ.). Phys. Lett.; 40A: No. 2, 175-6(3 Jul 1972).

Experiments demonstrating the satellite generation of the unstable plasma wave in a modulated electron beam—plasma system are described. The spatially periodic energy transfer among the satellite modes and the primary mode is observed, which results in decrease in the growth rate of the primary mode. (auth)

44415 STABILIZATION OF NONUNIFORM MAGNETIZED PLASMA BY HIGH-FREQUENCY ELECTRIC FIELD. Gutkin, T. I.; Boleslavskaya, G. I. (Sukhumi Physical-Technical Inst., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1415-20(Sep 1971). (In Russian).

Some instabilities of collisionless slightly nonuniform plasma in a strong constant magnetic field and a hf electric field are investigated. Stabilization is studied within a wide frequency range depending on the high-frequency field intensity. Particular attention is paid to the range of relatively low frequencies where the nonuniform plasma stabilization becomes possible. (auth)

44416 EFFECT OF COLLISION ON PARAMETRIC INSTABILITY IN A PLASMA. Gupta, M. R. (University Coll. of Science, Calcutta). Indian J. Phys.; 45: No. 3, 107-20 (Mar 1971).

The effect of collision on the threshold energy level for onset of parametric instability in a plasma was determined by solving the Boltzmann equation in an external field $E_0 \sin(k_0 \cdot r - \omega_0 t)$ with Bhatnagar, Gross, and Krook collision terms. It is found that collisions lead to the enhancement of threshold level by the factor $[1 - \sqrt{(\pi/2)}(\nu/kv_0 e)]^{-1}$ which becomes appreciable in a weakly ionized plasma. (auth)

44417 ENHANCED SCATTERING INHERENT TO LOSS-CONE PARTICLE DISTRIBUTIONS. Baldwin, D. E. (Univ. of California, Livermore); Callen, J. D. Phys. Rev. Lett.; 28: No. 26, 1686-8(26 Jun 1972).

Particle scattering due to a Rosenbluth—Post convective loss-cone instability is calculated using a slab model. This collective contribution to the scattering rate is found to be the classical scattering rate increased by a factor $(T_i/T_e)^{3/2}(m_e/m_i)^{1/2}(\ln\Lambda)^{-1} \times$ (energy amplification of the convective instability in the finite plasma). (auth)

44418 LEVITATION AND STABILIZATION OF A SINGLE PARTICLE BY USE OF NEGATIVE FEEDBACK. Harries, W. L.; Dimock, D. (Princeton Univ., N. J.). Rev. Sci. Instrum.; 43: No. 8, 1093-4(Aug 1972).

An optical sensing and electrical feedback system is described that will damp out the orbital motion of a particle levitated in a three-phase electric field. This eliminates the necessity of introducing a background gas for this purpose. (auth)

44419 CHARACTERISTICS OF DENSITY FLUCTUATIONS IN AN UNSTABLE RADIO-FREQUENCY GENERATED PLASMA DERIVED FROM SCATTERING OF ELECTROMAGNETIC WAVES AT 24 GHz. Brooks, D. (Univ. of Montreal, Quebec). Plasma Phys.; 14: No. 3, 351-5(Mar 1972).

Some results of an experiment whose principal end is a study of the growth and form of the ion-acoustic two-stream instability, produced by particle drifts perpendicular to an applied magnetic field, are reported. (UK)

Thermonuclear Processes

44420 (UCRL—73880) REFRIGERATION FOR THE LIVERMORE SUPERCONDUCTING LEVITRON. Duffy, T. J.; Taylor, C. E. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Apr 1972. 16p. (CONF-720803—2). Dep. NTIS.

From Cryogenic engineering conference; Boulder, CO. (9 Aug 1972).

The Livermore Superconducting Levitron has 19 coils consisting of an 80-cm-diam superconducting floating ring, an array of three pairs of dc superconducting coils 50-, 112-, and 160 cm in diameter, and 12 superconducting pulsed control coils 48 cm in diameter. High-purity aluminum plates above and below the floating ring act as passive control elements by damping the ring motion. These plates require helium-temperature refrigeration to achieve the high-resistivity ratio (3000 : 1) required. The floating ring is cooled and recooled periodically by conduction through mechanical clamps. This cold assembly of about 2000-kG mass is connected through an elaborate plumbing system to a bottom outlet dewar. Liquid helium circulates between the dewar, ring-cooling clamps, and cold assembly by natural convection currents. The assembly is suspended in an ultra-high-vacuum chamber from the chamber lid. Radiation from the walls of the vacuum chamber is intercepted by a nitrogen-temperature liner. The liner, together with all the vacuum auxiliaries, is fed from a central source, and the liquid nitrogen circulates by natural convection. (auth)

44421 PLASMA-JET GENERATOR WITH NONCYLINDRICAL ELECTRODE GEOMETRY. Azizov, E. A.; Komel'kov, V. S. (Inst. of Atomic Energy, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 163-5(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 203-6(Jan 1972).

A pulsed injector producing a plasma jet with an electron density of 2×10^{17} cm^{-3} is described. The high density is achieved by the conical geometry of the accelerating electrodes. For low currents (~10 to 20 kA) the zone of highest density is in the region of the geometrical vertices of the cones. For currents of hundreds of kiloamperes, the zone of greatest n (focus) is shifted towards the muzzle. The focused plasma flow lasts for ~5 to 15 μsec. Transition from a pulsed to a quasi-steady flow is revealed by an interferometer method. The diameter of the focused region is 2 to 3 cm and the plasma temperature is 10 to 13 eV. (auth)

44422 HIGH-CURRENT RELATIVISTIC ELECTRON BEAMS. Kopecky, Vladimir (Ustav pro Fysiku Plasmatu, Prague). Cesk. Cas. Fys.; 22: No. 2, 153-61(1972). (In Czech).

The term high-current relativistic electron beams is intended to mean beams with electron energies of several MeV and currents of several tens of kA and over. Associated with high-current relativistic beams are some interesting properties, such as self-focusing, reflections from conductive walls, and target explosion. Theoretical and experimental results are reviewed, and prospects of using such beams, for example, in thermonuclear synthesis, acceleration techniques, and nondestructive testing are outlined. (auth)

44423 PROSPECTS OF THERMONUCLEAR FUSION REACTORS IN LIGHT OF NEW RESULTS OF HIGH TEMPERATURE PLASMA PHYSICS RESEARCH. Sunka, Pavel (Ustav pro Fysiku Plasmatu, Prague). Cesk. Cas. Fys.; 22: No. 2, 139-52(1972). (In Czech).

Latest experimental results in thermonuclear research are summarized, and probable trends of future development in its various branches are assessed. The conception of a fusion reactor based on long-time confinement of high-temperature plasma is explained. The experimental results achieved so far justify hopes for successful realization of an economically profitable energy source. (auth)

44424 THERMODYNAMIC ANALYSIS OF FUSION REACTORS. Petrie, T. W.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 1, 30(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44425 LIMITS ON THE THERMAL EFFICIENCY OF FUSION REACTORS. Petrie, T. W.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 1, 30-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44426 DESIGN NOTES FOR FUSION REACTOR MAGNETS. Boom, R. W.; Young, W. C. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 32(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44427 BREEDING RATIO, INVENTORY, AND DOUBLING TIME IN A D-T REACTOR. Vogelsang, W. F. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 33-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44428 TOKAMAK SCALING IN TERMS OF CRITICAL FIELDS AND PLASMA STABILITY. Forsen, H. K.; Emmert, G. A.; Tang, T. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 32-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44429 NEUTRON SOURCE GEOMETRY EFFECTS ON FUSION REACTOR BLANKETS. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 34-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44430 PARAMETER STUDY OF A PULSED HIGH-BETA FUSION REACTOR. Burnett, S. C.; Ellis, W. R.; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 36-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44431 GAS-DYNAMIC FUEL CYCLING IN A PULSED FUSION REACTOR. Oliphant, T. A.; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 37(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44432 NEUTRONIC CHARACTERISTICS OF A PULSED-FUSION REACTOR USING LASER-INITIATED (D+T) PELLETS. Watson, Clayton W. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 37-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44433 DIRECT CONVERSION SCHEME FOR LARACTORS. Rao, Meka Papa; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 1, 38-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44434 CONTROLLED THERMONUCLEAR REACTOR AS A FISSION PRODUCT BURNER. Wolkenhauer, W. C. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 92-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44435 TRAPPING OF HIGH-CURRENT RELATIVISTIC ELECTRON BEAMS IN A MAGNETIC MIRROR TRAP. Bzura, J. J.; Fessenden, T. J.; Fleischmann, H. H.; (and others) (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett.; 29: No. 5, 256-9(31 Jul 1972).

Electron beams (500 keV, 10 kA) are injected into a magnetic mirror trap of Astron geometry without wall resistors. When using H_2 and pressures of several hundred millitorr in the tank, one observes ring-shaped electron layers exhibiting field changes $\rho = \delta B/B_{vac}$ of up to 120% in the trap center and lifetimes of up to 20 μsec. With the exception of a fast final "dump" when the ρ of the layer has decreased to small values, one observes a smooth decay of the layer roughly compatible with scattering of the fast electrons in the background gas. (auth)

44436 PLASMA IN THE TOKAMAK. Artsimovitch, L. A. (Academy of Sciences, Moscow). Comments Plasma Phys. Controlled Fusion; 1: No. 1, 1-7(1972).

The following areas are briefly discussed: the actual known plasma properties in Tokamaks, the improvement of existing experimental data, correlation between theory and experiment, and the prediction of plasma properties in larger installations. (M.O.W.)

44437 MULTI-SPECIES FOKKER–PLANCK CALCULATIONS FOR D–T AND D–^{3}He MIRROR REACTORS. Futch, A. H. Jr.; Holdren, J. P.; Killeen, J.; Mirin, A. A. (Univ. of California, Livermore). Plasma Phys.; 14: No. 3, 211-44 (Mar 1972).

Values of the confinement parameter $n\tau$ and the figure of merit Q (the ratio of thermonuclear power to injected power) are obtained for postulated reactor conditions. The heart of the work is the numerical solution, under tested assumptions, of the coupled Fokker–Planck equations for as many as six charged species. The present results are compared with previous work (where applicable), with analytical/empirical approximations, and with a separate code treating velocity space more rigorously for a single positive species. (UK)

44438 RECENT DEVELOPMENTS IN HIGH-BETA PLASMA RESEARCH ON θ AND Z PINCHES. Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). Comments Plasma Phys. Controlled Fusion; 1: No. 1, 17-22(1972).

A brief summary is given of recent world-wide research on pinch devices. Current developments toward toroidal pinch research are described. (M.O.W.)

44439 PROSPECTS OF THE CONTROLLED NUCLEAR FUSION. Mazzucato, E. (EURATOM–CNEN, Rome). Energ. Nucl. (Milan); 19: No. 6, 380-9(Jun 1972). (In Italian).

The present status of research work in the field of controlled nuclear fusion and the prospects of such a process are presented. First, the conditions required for its taking place are examined; the plasma confinement systems are then described. The magnetic configurations of interest to fusion (open and toroidal) are illustrated, and finally the characteristics of a fusion reactor and the technological problems presented by such an achievement are outlined. (auth)

Wave Phenomena

Refer also to abstract 43850.

44440 (COO–3004-3) INVESTIGATIONS IN PLASMA DYNAMICS. Annual Progress Report. Schmidt, George (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Jun 1972. Contract AT(11-1)-3004. 8p. Dep. NTIS.

During the contract year, investigation of large-amplitude waves continued with a number of new results. The compression of E layers was also studied. Since most of this work is either published or is in the process of publication only a brief review of various areas of investigation is given here. (auth)

44441 (JINR–P9-6432) NUMERICAL INVESTIGATIONS OF EVOLUTION OF LANGMUIR WAVE SPECTRA IN TURBULENT PLASMA. Getmanov, B. S.; Makhan'kov, V. G.; Shchinov, B. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1972. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

The behavior in time of different isotropic packets of the Langmuir waves is numerially investigated practically in all the region of the wave numbers k. The processes of induced scattering of oscillations on plasma ions and plasmon–plasmon interactions are taken into account. In the cases considered, the energy transfer is possible through a set of satellites and the diffusion-packet drift. Plasmon–plasmon interactions accelerate the packet motion to small k and also change its form. The corresponding graphs are presented. (auth)

44442 (N–72-15666) ELECTROMAGNETIC PLASMA-WAVE PROPAGATION ALONG A MAGNETIC FIELD. Olson, Craig Lee (California Univ., Los Angeles. Plasma Physics Group). Jun 1970. Contract AT(04-3)-34. 264p. (NASA-CR-125416). NTIS. Thesis.

The linearized response of a Vlasov plasma to the steady-state excitation of transverse plasma waves along an external magnetic field is examined. Assuming a delta-function excitation mechanism, and performing a detailed Vlasov–Maxwell equation analysis using Fourier–Laplace transforms, the plasma response is found to consist of three terms: a branch-cut term, a free-streaming term, and a dielectric-pole term. Also considered is the phenomenon of plasma-wave echoes. The case of longitudinal electrostatic waves is extended to the case of transverse plasma waves that propagate along an external magnetic field. It is shown that a transverse echo results in lowest order only when one excitation is transverse and the other is longitudinal. (auth) (STAR)

44443 (N–72-16610) WAVE GROWTH IN A STRONGLY TURBULENT PLASMA. Birmingham, T. J.; Bornatici, M. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sep 1971. 19p. (NASA-TM-X-65802; X-641-71-321). NTIS.

An equation is derived for the average nonlinear growth (damping) rate of an electrostatic mode with wave vector k for an ensemble of electrostatically turbulent, unmagnetized plasmas. Strong turbulence alters particle orbits during the course of wave growth and, hence, brings particles in and out of resonance with the wave. The wave growth rate in a strongly turbulent plasma therefore depends on the initial velocity distribution of particles not only at the wave speed, but in the vicinity of this speed as well. Two orbital effects are considered: turbulence modification of ensemble average orbits and turbulence-produced orbital dispersion about the average orbits. Both contribute to a resonance broadening. (auth) (STAR)

44444 SHOCK-WAVE ACCELERATION IN A GAS WITH A DENSITY GRADIENT. Voitenko, A. E.; Lyubimova, M. A.; Sobolev, O. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 85-7(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 111-14(Jan 1972).

The acceleration of a shock wave in a medium with a density gradient is studied experimentally. An increase in the front velocity by a factor of four is found. The experimental results are compared with calculations. (auth)

44445 ELECTROMAGNETIC RADIATION NEAR THE ION PLASMA FREQUENCY EMITTED BY A TURBULENTLY HEATED PLASMA. Rutgers, W. R. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Phys. Lett.; 40A: No. 2, 99-100(3 Jul 1972).

The microwave radiation spectrum from a turbulently heated plasma was measured in detail. Characteristic frequencies of the ion—acoustic instability and the electron—ion two-stream instability are observed. (auth)

44446 FAST-WAVE DAMPING AT THE SECOND HARMONIC OF THE ION CYCLOTRON FREQUENCY. Cato, J. E. (Texas Tech. Univ., Lubbock); Kristiansen, M.; Hagler, M. O.; Watson-Munro, C. N. Phys. Lett.; 40A: No. 2, 141-2(3 Jul 1972).

Wave damping was predicted and observed to occur for the fast (right-hand polarized) wave at the second harmonic of the ion cyclotron frequency. (auth)

44447 PROPAGATION OF POTENTIAL SURFACE WAVES IN NONHOMOGENEOUS PLASMAS AT THE PLASMA RESONANCE IN THE TRANSITION LAYER. Demchenko, V. V.; Zayed, K. E. (Atomic Energy Establishment, Cairo). Physica; 59: No. 3, 385-400(1 Jun 1972).

An investigation is made of surface-wave damping due to collisions in a narrow transition layer between plasmas with opposite dielectric permeabilities in a region where the wave frequency is close to the Langmuir frequency of the plasma electrons. Dispersion equations, taking the damping into account, and expressions for resonance absorption of the wave were obtained both for plane and cylindrical geometries. The process of linear transformation of surface waves, caused by the initial perturbation, into Langmuir oscillations in the region of a strongly inhomogeneous plasma is also studied. It was demonstrated that surface waves, for a period of time determined by the width of the transition region, are transformed into longitudinal oscillations concentrated in the transition layer and directed along the plasma-density gradient. (auth)

44448 CONTINUUM EIGENMODES OF AN INHOMOGENEOUS PLASMA. Sedlacek, Z. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 22: No. 6, 439-58(1972).

The van Kampen—Case treatment of the linearized Vlasov equation is generalized to cases of nonuniform plasmas in nonuniform equilibrium fields. This is done by transforming the Vlasov operator into the representation of the eigenfunctions of the streaming operator. The Vlasov operator is thus reduced to the form of a multiplication operator perturbed by an integral operator so that the continuum eigenfunctions may be constructed by adapting a method originally devised in neutron transport theory. The calculation leads to solving a nonsingular Fredholm-type integral equation. Various kinds of degeneracy of the continuous spectrum are discussed and an example is given. (auth)

44449 EXPERIMENTAL OBSERVATION OF NONLINEAR WAVE—PARTICLE INTERACTIONS IN A WEAK COLD BEAM—PLASMA SYSTEM. Mizuno, Katsuhiro; Tanaka, Shigetoshi (Kyoto Univ.). Phys. Rev. Lett.; 29: No. 1, 45-8(3 Jul 1972).

Nonlinear evolution of a beam—plasma instability was investigated by direct measurements on the energy distribution of beam electrons and the field intensity of an externally driven electrostatic wave. The initial exponential growth of the excited single wave is halted when the wave traps the electrons and rotates them in phase space. At the phase of spatial bunching of the beam, its harmonics are observed to have maximum values. The results agree with those predicted by a single wave model. (auth)

44450 COLLISIONLESS WAVE—PARTICLE INTERACTIONS PERPENDICULAR TO THE MAGNETIC FIELD. Wong, A. Y.; Jassby, D. L. (Univ. of California, Los Angeles). Phys. Rev. Lett.; 29: No. 1, 41-5(3 Jul 1972).

The collisionless interaction between particles undergoing $\vec{E} \times \vec{B}$ drift and Kelvin—Helmholtz instabilities propagating across a strong magnetic field is investigated using a test-wave technique. Orbit perturbations in phase space are observed with increasing instability amplitude. Direct measurements of finite—Larmor-radius effects are also presented. (auth)

44451 ELECTRON—PLASMA-WAVE SHOCKS IN A BOUNDED PLASMA. Saeki, K.; Ikezi, H. (Nagoya Univ., Japan). Phys. Rev. Lett.; 29: No. 5, 253-5(31 Jul 1972).

Large-amplitude electron plasma waves in a bounded plasma are observed to steepen and to form shock waves with trailing wave trains. For larger-amplitude shocks, however, the trailing wave trains are found to disappear. (auth)

44452 OSCILLATION PROFILE OF SHOCK WAVE IN PLASMA. Akhiezer, A. I.; Polovin, R. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); No. 9, 1467-72(Sep 1971). (In Russian).

The effect of intrinsic viscosity in ion and electron components of plasma, as applied to the shock wave structure in plasma, is investigated. The shock-wave profile is shown to be essentially dependent on a relative role of viscosity and friction force between the plasma separate components. (auth)

44453 PROPAGATION OF LANDAU WAVES IN A DIFFUSION PLASMA. Le Coquil, E.; Henry, D.; Le Meur, J. P.; Castrec, C.; Trequier, J. P. (Centre National d'Etudes des Telecommunications, Lannion, France). Rev. Phys. Appl.; 6: No. 4, 467-73(Dec 1971). (In French).

Experimental equipment enabling longitudinal electrostatic waves to be detected in a hot collisionless plasma in the absence of a magnetic field is described. These waves are excited at frequencies $\omega_p < \omega < 1.6\ \omega_p$ by a plane grid capacitor and detected by a wire probe. The results obtained permit the determination of the dispersion curve and the variations in attenuation as a function of the frequency. Values are calculated for the plasma frequency (accuracy 4%), Debye length (accuracy 6%), and electronic temperature (accuracy 20%) from the experimental data and the theoretical dispersion curve, $D(\omega,k) = 0$. The validity of the results obtained is discussed. They are compared with results deduced from Langmuir probe measurements. The agreement between these results is satisfactory. Plasma diagnostics studies were accomplished by direct measurement of the impedance of the capacitor. (France)

44454 POLARIZATION OF AN e.m. WAVE PROPAGATING IN A PLASMA WITH MAGNETIC SHEAR. THE MEASUREMENT OF POLOIDAL MAGNETIC FIELD IN TOKAMAK. De Marco, F.; Segre, S. E. (EURATOM-CNEN, Frascati, Italy). Plasma Phys.; 14: No. 3, 245-52(Mar 1972).

The evolution of the polarization state of an electromagnetic wave propagating in a nonhomogeneous plasma with a sheared magnetic field is studied. A differential equation is given describing such evolution in the case of slowly varying plasma parameters. Assuming the model of a cold collisionless plasma, an approximate solution giving the output polarization as a function of the input one and of the plasma parameters along the path is obtained. These results are applied to the case of a Tokamak; it is shown that in some particular cases the output polarization is a relatively simple functional of the poloidal magnetic field. (auth)

44455 PROPAGATION AND ABSORPTION OF ION HYBRID WAVES IN A WEAKLY INHOMOGENEOUS PLASMA LAYER. II. Glagolev, V. M. (Inst. of Atomic Energy, Moscow). Plasma Phys.; 14: No. 3, 315-26(Mar 1972).

The dispersion equation for ion-hybrid waves, obtained from the kinetic equation for a collisionless plasma, is analyzed. The conditions for transformation of the electromagnetic wave into a plasma wave are given. The absorption of waves on both electrons and ions is found. (UK)

44456 PROPAGATION AND ABSORPTION OF ION HYBRID WAVES IN A WEAKLY INHOMOGENEOUS PLASMA LAYER. I. Glagolev, V. M. (Inst. of Atomic Energy, Moscow). Plasma Phys.; 14: No. 3, 301-14(Mar 1972).

The problem of electromagnetic wave propagation and absorption in a weakly inhomogeneous plasma layer (in the geometrical optics approximation) is solved. The plasma density increases in the direction perpendicular to the magnetic field. The excitation of the waves occurs in the low density region. It is shown that deceleration of the wave along the magnetic field is necessary for its propagation into the plasma layer. As the wave penetrates the plasma layer its phase velocity reduces, and at a certain plasma density the electromagnetic wave transforms into a plasma wave. The conditions for such a transformation of electromagnetic wave into plasma wave are calculated in the hydrodynamic approximation. (auth)

44457 NONLINEAR GENERATION OF SUM AND DIFFERENCE FREQUENCIES IN A HOMOGENEOUS MAGNETOPLASMA BY NONUNIFORM MICROWAVE FIELDS. Mittal, R. S. (Delhi Univ.); Gupta, G. P. Indian J. Pure Appl. Phys.; 9: No. 5, 275-80(May 1971).

Explicit expressions for the sum and difference frequency and second harmonic components of the current density in a homogeneous magnetoplasma due to the nonuniform nature of the applied electric fields are derived, using rigorous kinetic theory techniques. A general power law for the dependence of electron collision frequency on electron velocity is used. Some numerical results depicting the phenomenon of resonances for some simple interesting situations are presented. (auth)

44458 PROPAGATION OF SOUND WAVES IN A FULLY IONIZED GAS. Bhatnagar, V. P. (Delhi Coll. of Engineering);

Shrivastava, D. K.; Bhatnagar, D. P. Indian J. Pure Appl. Phys.; 9: No. 5, 271-4(May 1971).

The propagation of sound waves in a nonisothermal plasma is considered for a situation where the collisions between various particles cannot be ignored. From hydrodynamical considerations, it is shown that a low-frequency wave travels with a velocity $\sqrt{\gamma K(T_i + T_e)/m_i}$ and shows little or no damping. Another low-frequency wave may also propagate with a velocity $[2\omega_e/\nu_{ei}(\sqrt{\gamma KT_e/m_e})(T_i/T_i + T_e)^{1/2}]$. However, this wave is subjected to a very large damping and hence is of very little importance. As the frequency of the sound wave is increased so as to approach the electron plasma frequency, the velocity of propagation of the undamped wave decreases and ultimately reaches a value $\sqrt{\gamma KT_i/m_i}$. When the frequency of the sound wave becomes equal to or more than the electron plasma frequency, this wave continues to propagate with the same velocity. However, at such higher frequencies, another wave starts propagating with a velocity $\sqrt{\gamma KT_e/m_e}$ and is subjected to a damping of $\nu_{ei}/2\sqrt{\gamma KT_e/m_e}$. (auth)

44459 INFLUENCE OF ELECTRON AND ION PRESSURE NEAR THE LOWER HYBRID RESONANCE. Babu, R.; Lammers, B.; Schlueter, H. (Ruhr Univ., Bochum, Ger.). Z. Naturforsch.; 27b: No. 6, 930-8(Jun 1972).

Near the lower hybrid resonance the power transfer from electromagnetic waves to a plasma cylinder is calculated, with the inclusion of electron and ion pressures. Ion–electron collisions are accounted for, in addition to the collisions of charged particles with neutrals. Drastic deviations from calculations that neglect pressure effects occur for plasmas of low electron density and/or small radial extent. Different ranges of a specific ratio comparing the influence of collision with that of pressure terms are investigated. (auth)

44460 AZIMUTHALLY SYMMETRIC UNIDIRECTIONAL ION CYCLOTRON WAVE EXCITER. Hipp, J. E.; Kristiansen, M.; Hagler, M. O. (Texas Technological Univ., Lubbock). J. Appl. Phys.; 43: No. 8, 3590-1(Aug 1972).

A unidirectional device for excitation of azimuthally symmetric ($m = 0$) ion cyclotron waves is proposed. This work is related to the $m = \pm 1$ traveling wave coupler described earlier by the authors. The $m = 0$ coupler is analyzed theoretically, and numerical calculations are made of maximum loading resistance and directivities as functions of plasma density. Directivities of better than 0.99 are found. (auth)

44461 NOTE ON THE BANDWIDTHS OF ELECTROMAGNETIC ION CYCLOTRON HARMONIC WAVES IN PLASMAS. Lee, Kai Fong (National Oceanic and Atmospheric Administration, Boulder, Colo.). J. Appl. Phys.; 43: No. 8, 3586-7(Aug 1972).

It is shown that the propagation bandwidths of electromagnetic ion cyclotron harmonic waves in hot and collisionless plasmas are of the order $(T_{\parallel i}\, m_c/T_{\perp i}\, m_i)\,\Omega_i$ where $T_{\parallel i}/T_{\perp i}$ is the ratio of parallel to perpendicular ion temperatures, Ω_i is the ion cyclotron frequency, and m_c/m_i is the electron-to-ion mass ratio. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 43119, 43918, 44186, 44536, and 44570.

44462 (AEEW-M-730) AN INVESTIGATION OF A MONTE CARLO TREATMENT OF THERMAL NEUTRON SCATTERING. Basher, J. C.; Pull, I. C. (Atomic Energy Establishment, Winfrith (England)). Jan 1969. 40p. Dep. NTIS (U. S. Sales Only).

The work on the extension to the IBM 7090 neutronics Monte Carlo code, MOCUP, to cover thermal neutron energies is described. It describes the thermal model as originally envisaged and implemented in MOCUP, the tests to validate the model, and the investigations undertaken to improve the model. (The original MOCUP program is described in AEEW-R-243.) (auth)

44463 (JAERI-Memo-4001) DEVELOPMENT OF IRRADIATION TECHNICS. I. DEPTH DOSE DISTRIBUTION BY ELECTRON BEAM IRRADIATION. Oshima, Y.; Tazima, S.; Tanaka, R. (Japan Atomic Energy Research Inst., Tokyo). May 1970. 21p. (In Japanese). Dep. NTIS (U. S. Sales Only).

A preliminary report is presented containing the results of research carried out in JAERI intended for use by JAERI personnel. (M.H.R.)

44464 (LA-DC-13293) AIR TRANSPORT CALCULATIONS USING THE LASL-NWEF NEUTRON-GAMMA AIR FLUX TAPE AND THE NWEF COMPUTER PROGRAM CDR. Campbell, J. E. (Naval Weapons Evaluation Facility, Kirtland AFB, N. Mex.); Sandmeier, H. A. (Los Alamos Scientific Lab., N. Mex.). 12 Nov 1971. 18p. (CONF-711125-7). Dep. NTIS.

From Radiation Shielding Information Center seminar-workshop; Oak Ridge, Tenn. (15 Nov 1971).

Complete transport calculations were performed in uniform, sea-level air for one source neutron in each of 30 energy groups and one source photon in each of 12 energy groups. The computer program CDR (Constant Dose Range) is used to scale these results to produce ranges of constant dose from a point source of radiation in the atmosphere. A sample problem is included. (M.H.R.)

44465 (LA-DC-13294) TWO-DIMENSIONAL COUPLED NEUTRON-GAMMA S_n TRANSPORT FROM A 14.1-MeV NEUTRON SOURCE IN AIR OVER GROUND USING THE LASL TWOTRAN-FC PROGRAM. Sandmeier, H. A.; Lathrop, K. D.; Brinkley, F. W.; Hansen, G. E. (Los Alamos Scientific Lab., N. Mex.); Campbell, J. E. (Naval Weapons Evaluation Facility, Kirtland AFB, N. Mex.). Nov 1971. 11p. (CONF-711125-9). Dep. NTIS.

From Radiation Shielding Information Center seminar-workshop; Oak Ridge, Tenn. (15 Nov 1971).

The neutron ionizing Rad(Si) and gamma Rad(Si) dose from a 14.1 MeV neutron (1 neutron) source were evaluated at 100 m above the ground. The results are compared with previous work. (M.H.R.)

44466 (LUIP-CR-72-5) TABLE OF PARAMETERS FOR HEAVY ION TRACKS IN NUCLEAR EMULSIONS. Rosander, R.; Larsson, L. (Lund Univ. (Sweden). Dept. of Physics). Mar 1972. 60p. Dep. NTIS (U. S. Sales Only).

Relations between a number of track parameters useful in nuclear emulsion analyses have been computed. The table includes the following quantities: residual range, velocity, kinetic energy per nucleon, effective charge, energy loss of heavy ions, maximum energy and practical range for secondary electrons. The calculations have been performed for isotopes of interest in cosmic ray work with charges in the interval $2 \leq Z \leq 28$ and for residual ranges $R \leq 30$ cm. In an appendix we give the velocity, the γ-factor and the momentum of a nucleon as a function of kinetic energy. (auth) (Sweden)

44467 ELECTRON SCATTERING IN SINGLE CRYSTALS. Vorob'ev, A. A.; Bobudaev, A. Ya.; Vorob'ev, S. A.; Caplin, V. V. (Tomsk Polytechnical Inst., USSR). Phys. Lett.; 40A: No. 2, 105-6(3 Jul 1972).

The backscattering and transmission yields for electrons in NaCl single crystals were measured. In relatively thin crystals, the effect of anomalous electron penetration was revealed. (auth)

44468 ELECTRON SLOWING-DOWN-CASCADE SPECTRA IN SOLIDS. Ritchie, R. H.; Anderson, V. E. (Oak Ridge National Lab., Tenn.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 141-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Inelastic cross sections were constructed from the electron gas model. To describe excitations from deeper-lying levels than valence electrons, both classical and quantal approximations were used. The contributions from Auger cascade electrons were estimated. (M.H.R.)

44469 COMPUTATION OF PHOTON-RADIATION-INDUCED ELECTRON EMISSION. Chadsey, William L. (General Electric Co., Philadelphia); Kohlberg, Ira. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 150-61(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The limitations of analytical models due to the neglect of Auger and secondary contributions to the emission current and due to the neglect of electron multiple scattering in the emission calculation are examined. A one-dimensional model is developed for predicting the relative magnitudes of the photoelectron, Compton, Auger, and secondary electron contributions to the emission current, and the model predictions are correlated with experimental data. It is concluded that a generally applicable emission model should include treatment of the Auger and secondary electrons as well as the photoelectrons and Compton electrons. The significance of electron multiple scattering in the calculation of the emission is examined through comparisons of analytical, Monte Carlo, and experimental data. It is concluded that while multiple scattering may be neglected in the calculation of forward emission efficiency, it must not be neglected in the calculation of backward emission efficiency or angular distribution of emission. An alternative emission computational model is introduced which utilizes a synthesis of analytical and Monte Carlo techniques. Comparisons of the model predictions to experimental data for forward and backward emission efficiency, energy spectrum, and angular distribution are included. (auth)

44470 IONIZATION, SECONDARY EMISSION, AND COMPTON CURRENTS AT GAMMA-IRRADIATED INTERFACES. Frederickson, A. R.; Burke, E. A. (Air Force Cambridge Research Labs., Bedford, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 162-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Energy and charge transport by secondary electrons across interfaces between gamma-irradiated materials can be important for accurate predictions of radiation effects. In order to measure these charge-transport effects, air ionization and secondary electron emission currents were observed in a multiple-cavity aluminum chamber adjacent to tungsten and beryllium under ^{60}Co γ radiation. It was found that low-energy secondary emission measurements are within 3% of air ionization measurements made in the same chamber and that both measurements agree with previously reported ionization measurements of energy deposition profiles. Also, profiles obtained in relatively thin aluminum chambers ($\sim$20% of the maximum energy electron range), sandwiched between different combinations of beryllium and tungsten, can be accurately predicted from a linear superposition of single interface data. Finally, electric charge separation is observed at gamma-irradiated boundaries even in the absence of applied electric fields. The sign and magnitude of the charge is found to depend upon the direction of the incident beam as well as the material combination. The change in electron current as a function of the distance from the interface can be obtained from the data presented. (auth)

44471 PHOTOELECTRON CURRENTS AND FIELDS IN AIR-FILLED CAVITIES. Singletary, L. D.; Kelleher, D. (Braddock, Dunn and McDonald, Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 170-7(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A model was developed to facilitate the calculation of electron transmission currents and potentials generated in partially gas-filled enclosures as a result of photon irradiation. The significance of the presence of air or any ionizable gas in modifying electron transmission currents and potentials is emphasized in the analysis. A computer code was developed to perform detailed calculations. The parametric variations of transmitted current and potential as a function of pressure, gap spacing, time, pulse shape, and incident intensity are illustrated by representative calculations. (auth)

44472 NATURAL NUCLEAR RADIATION ENVIRONMENTS FOR THE GRAND TOUR MISSIONS. Haffner, J. W. (North American Rockwell Corp., Downey, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 443-56(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The solar flare, galactic, and magnetically trapped (Van Allen) nuclear particle radiation environments expected on three outer planet "Grand Tour" missions were calculated. The missions are the 1977 4-planet mission (Jupiter–Saturn–Uranus–Neptune), the 1977 3-planet mission (J–S–P), and the 1979 3-planet mission (J–U–U). The planetary Van Allen belts contribute the largest doses behind 1 gm/cm^2 shielding of aluminum. For the 1977 4-planet mission, which passes within 2.6 planet radii of Saturn, Saturn's Van Allen belts may contribute as much as 95% of the total dose of 5300 rads. For the 1977 3-planet mission, which passes within 4.3 planet radii of Jupiter, Jupiter's Van Allen belts contribute 90% of the calculated total dose of 1900 rads. The 1979 3-planet mission dose of 600 rads is due to approximately equal contributions of solar flare particles, galactic (cosmic ray) particles, and Jupiter's Van Allen belts (periapsis at 6.7 Jupiter radii). (auth)

44473 DETECTION OF FAST PARTICLES BY THE DEFLECTION OF ELECTROMAGNETIC WAVES IN A TRAIN OF EXCITED STATES OF ATOMS ACCOMPANYING THE PARTICLE. Ryazanov, M. I. (Inst. of Engineering Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 7, 310-13(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 437-40(5 Apr 1972).

A particle moving in a substance excites continuously the atoms with which it collides in the substance it moves. The successive excitation of the immobile atoms along the particle path is equivalent to motion of a train of excited atoms. Owing to the difference between the dielectric constants and owing to the train motion, a plane electromagnetic wave passing through the excitation train is deflected and changes its frequency; this can be used to measure the particle velocity. A brief theory is described. (M.O.W.)

44474 INDUCED RADIATION OF RELATIVISTIC ELECTRONS MOVING IN A PLANE WAVE OF LOW INTENSITY. Ternov, I. M.; Bagrov, V. G.; Klimenko, Yu. I.; Pavlova, O. S.; Khalilov, V. R. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 12: No. 6, 691-6(1971). (In Russian).

Induced radiation from relativistic electrons is examined in a weak-wave approximation, wherein the electrons are moving in a plane electromagnetic monochromatic wave. Expressions are obtained for the probability and field strength of the radiation, and spin effects are investigated. (tr-auth)

44475 EFFECT OF IONIZING RADIATION ON THE BREAKDOWN OF LARGE GAPS IN AIR. Allibone, T. E.; Dring, D. (Univ. of Leeds, Eng.). Proc. IEEE (Inst. Elec. Electron. Eng.); 60: No. 2, 230-1(Feb 1972).

The influence of gamma radiation on the breakdown of a point-plane gap was studied, using impulse voltages of short and long wavefronts. The scatter of breakdown of some gaps is reduced by a factor of two, and the mean breakdown value is reduced by a few percent. (auth)

44476 INFLUENCE OF INSTRUMENT-DEPENDENT QUANTITIES UPON THE FORM OF THE β-RADIATION ABSORPTION CURVE. Belashov, V. G.; Bogachev, A. M. This paper was summarized in At. Energ. (USSR); 30: No. 1, 47(Jan 1971) as paper No. 458/5732. (In Russian).

An investigation of the analog and discrete recording methods for β radiation and the influence of instrument-dependent quantities (resolving time and relative recording efficiency) upon the form of the absorption of β radiation fluxes is described. A theoretical analysis of the influence of the recording method was made by modeling the interaction of the allowed Fermi spectrum of β particles with relatively thin foils. Expressions are given for the absorption curves recorded by an analog method and a discrete method, and the curves are compared. The influences of the resolving time and relative efficiency of the counting equipment are considered, and conclusions are presented. (W.H.K.)

44477 CALCULATION AND MEASUREMENT OF DEPTH-DOSE CURVES PRODUCED BY ELECTRON BEAM GENERATORS. Silverman, Joseph (Univ. of Maryland, College Park); Rosenstein, Marvin; Eisen, Harvey. Trans. Amer. Nucl. Soc.; 15: No. 1, 169(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44478 3-D CALCULATIONS OF NEUTRON DOSE FROM IMPLANTABLE ^{252}Cf SOURCES. Windham, J. P.; Shapiro, A.; Kereiakes, J. G. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 1, 171(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44479 CALCULATED GAMMA DOSE RATES FROM IMPLANTABLE ^{252}Cf SOURCES. Lin, Bo-in; Shapiro, A.; Windham, J. P.; Kereiakes, J. G. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 1, 171-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44480 CLOSING THE P_n EQUATIONS USING AN INTEGRAL EQUATION. Cullen, Dermott E. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 271(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44481 NEUTRON MODULATION BY DIFFRACTION FROM AN ADP PIEZOELECTRIC CRYSTAL. Parkinson, T. F.; Guermen, E.; Loyalka, S. K.; Muhlestein, L. D. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 15: No. 1, 472-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44482 FAST REACTOR FUEL FABRICATION DOSIMETRY STUDIES. Smith, R. C. (Westinghouse Hanford Co., Richland, Wash.); Faust, L. G. Trans. Amer. Nucl. Soc.; 15: No. 1, 541 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44483 DOSE LIMITS FOR NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN AIR. Albert, T. E. (Martin Marietta Corp., Orlando, Fla.). Trans. Amer. Nucl. Soc.; 15: No. 1, 552-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44484 SPECTRUM OF NEUTRONS PRODUCED BY 800-MeV PROTONS ON URANIUM. Veeser, L. R.; Fullwood, R. R.; Shunk, E. R.; Robba, A. A. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 15: No. 1, 555(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44485 NEUTRON TRANSPORT ON AIR: MOMENTS METHOD SOLUTION TO A BENCHMARK PROBLEM. Simmons, G. L.; Eisenhauer, C. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 564-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44486 CALCULATION OF GAMMA-RAY ENERGY-DEPOSITION RATES. Rohach, Alfred F. (Iowa State Univ., Ames). Trans. Amer. Nucl. Soc.; 15: No. 1, 574-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44487 EXPERIMENTAL VERIFICATION OF A MULTIGROUP GAMMA-RAY DIFFUSION CODE. Barry, K. M.; Trapp, G. E. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 576-7(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44488 EFFECT OF THE NUMBER OF SOURCE POINTS IN THE COMPUTATION OF GAMMA DOSE RATE BY POINT-KERNEL METHOD. Yeh, Cheng S. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc.; 15: No. 1, 577-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44489 FEW-GROUP S_n THERMAL X-RAY TRANSPORT WITH ANISOTROPIC COMPTON SCATTER. Stephan, Brian G. (Air Force Weapons Lab., Kirtland AFB, N. Mex.); Bridgman, Charles J. Trans. Amer. Nucl. Soc.; 15: No. 1, 579-80(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44490 ELECTRON TRANSPORT BY THE METHOD OF DISCRETE ORDINATES. Bartine, D. E.; Alsmiller, R. G. Jr.; Nynatt, F. R.; Engle, W. W. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 580-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44491 CALCULATION OF ELECTRON ENERGY FLUX DISTRIBUTIONS IN NOBLE GASES. Lo, R.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 1, 581-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44492 FUNCTION FITTING TO THE RANGE-ENERGY RELATION OF ELECTRONS. Ito, Rinsuke; Tabata, Tatsuo; Okabe, Shigeru. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 49-53 (1971).

One of the possible analytical expressions for the continuous slowing-down approximation (csda) range R_0 of electrons is presented. It is of the form: $R_0 = a_0\tau(1 + a_1\tau^{-1})/(1 + a_2\tau^{-1})\{1 + (\alpha\tau)^{\beta}\}$, where τ is the kinetic energy of electrons in units of the electron rest energy and α, β, and a_i ($i = 0, 1, 2$) are parameters depending on the atomic number Z of the stopping medium. Values of these parameters were determined from least-squares fit to the values of R_0 tabulated by Berger and Seltzer for energies 0.01 to 1000 MeV and for many kinds of medium. These parameters are also expressed by simple functions of Z ($\geqq 3$). The present expression for R_0 reproduces the values of Berger and Seltzer within an error less than a few percent, which is comparable to the errors of their calculations. (auth)

44493 METHOD OF CALCULATING THE BASIC PARAMETERS OF RADIATION INSTALLATIONS IN THE IRRADIATION OF STATIONARY SYSTEMS WITH ACCELERATED ELECTRONS. Nikulin, K. I. This paper was summarized in At. Energ. (USSR); 30: No. 5, 448-9(May 1971) as paper No. 490/5961. (In Russian).

Full copy of this paper is held by TIC.

In calculating the parameters of radiation installations used for carrying out processes in stationary systems (the cross-linking of polyethylene, the vulcanization of industrial rubber products, etc.), using accelerated electrons, one of the most important problems is to make sure that the absorbed doses are uniformly distributed throughout the volume of the irradiated material. A method for calculating the magnitudes of absorbed doses throughout the thickness of the material when it is irradiated with a wide beam of monoenergetic electrons is given. Irradiation methods which ensure that the absorbed doses will be uniform to within ±5% are proposed. Equations which can be used to determine the efficiency of utilization of the electron radiation in various methods of equalizing the magnitude of the absorbed dose throughout the thickness of the material are given. Also a method for calculating the basic parameters of radiation installations in the irradiation of stationary systems with a wide beam of monoenergetic electrons is discussed. (W.H.K.)

44494 THEORY OF VAVILOV–CHERENKOV RADIATION IN ANISOTROPIC MEDIA IN THE PRESENCE OF A BOUNDARY. Plis, A. I.; Safikhodzhaev, N. M. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 5, 364-9(1971). (In Russian).

The radiations from charged particles moving near the plane boundary between uniaxial anisotropic and isotropic media are considered. The optical axis of the crystal is supposed to be perpendicular to the boundary. The angular and spectral distributions of radiation are obtained in both crystal and isotropic media. (auth)

44495 ROLE OF AN INTEGRAL STREAM OF A PROTON BEAM IN PROTONOGRAPHY BY TRANS-ILLUMINATION. Markus, A. M.; Geguzin, Ya. E.; Fainshtein, A. L. (Physical-Technical Inst., Kharkov. Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 8, 1369-71(Aug 1971). (In Russian).

A monocrystalline film (4,500 Å thick) of Au was exposed to a 1-mm-diameter beam of 185-keV protons. A series of protonograms were obtained for a 1° angle between the beam and the normal to the film surface, corresponding to different values of Q, where Q = It (I = the intensity and t = the exposure time). The form of the protonogram varied with changes in the integral proton flux, and this phenomenon was attributed to "trans-illumination." (K.S.W.)

44496 RESULTS OF MEASUREMENTS OF THE LET X-RADIATION SPECTRA. Keirim-Markus, I. B.; Popov, V. I.; Krongauz, A. P.; Kolotilova, V. G.; Frolova, A. V. Med. Radiol.; 17: No. 5, 47-50(May 1972). (In Russian).

Results of an experimental determination of the dosage LET X-radiation spectra, generated at 50 to 220 kV, are presented. The spectra were measured by using a set of low-energy Geiger counters. The results are compared with the rated data and also with the data on the absorbed doses, obtained through measurements by means of ionization chambers. (auth)

44497 CALCULATION OF THE ELECTRON ENERGY SPECTRA IN HETEROGENEOUS TISSUE-EQUIVALENT MEDIA BY USING THE MONTE-CARLO METHOD. Pozdneev, D. B.; Mikheichev, V. V.; Kopytkin, Yu. V. (Gorky State Univ., USSR). Med. Radiol.; 17: No. 5, 50-61(May 1972). (In Russian).

Peculiarities common to procedures employed in estimating depth energy spectra in heterogenous tissue-equivalent media by the Monte Carlo method are described. Quantitative characteristics for normal incidence of an electron beam carrying an energy of 5 and 18 MeV on phantoms consisting of flat layers of the fatty, muscle, bony, and pulmonary tissues are reported. (auth)

44498 SIMPLIFIED METHOD OF ESTIMATING THE INTEGRAL (CUMULATIVE) ABSORBED DOSE BENEATH THE ANTI-DIFFUSE (FILTER) GRIDS IN AN ABSORBING MEDIUM. Devyatykh, Yu. N.; Morozov, A. I. (Moscow Scientific-Research Clinic Inst.). Med. Radiol.; 17: No. 5, 61-3(May 1972). (In Russian).

The proposed method is based on Meinord's formula and simplifies calculations, both in gamma- and x-ray therapy, that involve the use of gratings. The theoretically computed figures agree well with experimental data taken from the literature. (auth)

44499 CALCULATION OF THE ABSOLUTE DEPTH DOSE IN THE CENTRAL RAY OF A ^{60}Co RADIATION FIELD. Eisenlohr, H. H.; Abedin-Zadeh, R. (International Atomic Energy Organization, Vienna). Strahlentherapie; 143: No. 1, 90-7(Jan 1972). (In German).

Absolute depth doses in water for 1250-keV photon irradiation are calculated for different dimensions of circular cross sections. The approximation used takes into account Compton electrons of the first and second generation. For the electron stopping power, a series of linear functions obtained from tabulated data by the least-square method is used. For Compton electrons of the second generation a simplified assumption concerning their angular distribution is used. (auth)

44500 ELECTRON BACKSCATTERING COEFFICIENTS AT 12 TO 25 MeV FOR OBLIQUE INCIDENCE ON A METAL SURFACE. Kovalev, V. P.; Kharin, V. P.; Gordeev, V. V.; Isaev, V. I. At. Energ. (USSR); 32: No. 4, 342-4(Apr 1972). (In Russian).

The relative coefficients of electron backscattering during oblique incidence on the surfaces of Pb, Cu, Fe, and Al were measured over the energy range 12 to 25 MeV. A 1-cm electron beam of 3 to 5 μA from a linear accelerator was directed onto a metal specimen at a predetermined angle between 90 and 168°. The dependence of the backscattering coefficient on the angle of incidence is shown graphically. (K.S.W.)

44501 EXPERIMENTAL INVESTIGATION AND MATHEMATICAL APPROXIMATION OF THE DEPTH DOSE DISTRIBUTION OF FAST ELECTRONS. 1st COMMUNICATION. Czaikowski, P.-M. (Univ. of Saarland, Saarbrucken, Ger.). Strahlentherapie; 143: No. 2, 186-93(Feb 1972). (In German).

The dependence of the depth dose distribution of fast electrons in water on different physico-technical parameters was experimentally investigated. All measurements were performed using sintered LiF thermoluminescence detectors. Finally, the ascertained relations are discussed in connection with a method of calculating the depth dose curve, and suited for the planned irradiation. (auth)

44502 DEPTH DOSE TABLES FOR 42- AND 25-MV X-RAYS OF A 42-MeV BETATRON. Fehrentz, D.; Kuzma, I. (Univ., Heidelberg). Strahlentherapie; 143: No. 2, 194-6(Feb 1972). (In German).

For different field sizes and focus—surface distances of 100 and 120 cm, percentage depth doses for 42- and 25-MV x rays of a 42-MeV betatron from Siemens are presented. (auth)

44503 COMPARATIVE INVESTIGATIONS ON DOSE DISTRIBUTIONS IN MEGAVOLT THERAPY, IN THE REGION OF THE BASE OF THE SKULL. Fornusek, A. H.; Kuttig, H.; Fehrentz, D. (Univ., Heidelberg). Strahlentherapie; 143: No. 1, 1-11(Jan 1972). (In German).

Dose distributions for usual and appropriate irradiation methods in deep therapy of tumors situated in the base of the skull with ^{137}Cs- and ^{60}Co-radiation, as well as with ultrahard x rays of 15 and 42 MV, are specified and discussed. Under consideration of the exposure of bones, eyes, and other important organs, the authors deal with the question of the most favorable irradiation methods. (auth)

44504 COMPTON SCATTERING BY K-SHELL ELECTRONS. Murty, D. S. R.; Reddy, D. V. Krishna; Narasimhacharyulu, E. (Osmania Univ., Hyderabad, India). Indian J. Pure Appl. Phys.; 9: No. 5, 305-7(May 1971).

The incoherent scattering of gamma rays (662 keV) from cesium-137 (6C) by K-shell electrons of platinum, bismuth, and thorium was determined experimentally at $\theta = 50°$, using NaI(Tl) scintillation spectrometers and the fast-slow coincidence technique. The output pulses from the fast-slow coincidence circuit were passed on to a twenty-channel analyzer for display of the distribution of inelastically scattered gamma rays by K-shell electrons. The experimentally determined values of cross-section ratios compare closely with the values calculated on the basis of a formula given by Z. Sujkowski and B. Nagel (Ark. Fys., 20: 323(1961)) while differing considerably from values calculated on the basis of the formulas reported by Shimuzu et al. (Phys. Rev., 140: A1806(1965)). (auth)

44505 LUMINESCENCE YIELD IN ROENTGENOGRAPHY WITH HIGH-ENERGY X RAYS. Brandt, Werner; Stauber, Michael C. (Grumman Aerospace Corp., Bethpage, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 362-5(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A universal energy transfer function is derived that applies to absorption of x rays or gamma rays in all thin luminescent screens over a wide range of incident energies. This function is evaluated for monoenergetic incident radiation and for bremsstrahlung originating in gold targets. A scaled universal luminescence yield is given in terms of the energy transfer function minus an energy escape function, which accounts for the energy loss by electron escape from the phosphor. Under conditions where the energy escape is small, the dominant dependence of the luminescence yield on the phosphor appears only as a multiplicative material-characteristic constant. (auth)

Radiation Protection Standards

Refer also to abstract 43279.

44506 MEASUREMENT OF RADIATION QUALITY. Rossi, Harald H. (Columbia Univ., New York). Nucl. News; 14: No. 11, 53-6(Nov 1971).

The various units that give some measurement relative to radiation quality are discussed, such as RBE, LET, dose equivalent, lineal energy, and the dependence of specific energy on mass. The state of the art in measuring such quantities is mentioned. (M.H.R.)

Radiation Source Calibration and Standardization

Refer also to abstract 43279.

44507 CHOICE OF ENERGY FOR AN ACTIVATING RADIATION SOURCE IN INVESTIGATIONS WITH AN INACTIVE TAG. Tkachenko, V. I. (Inst. of Medical Radiology, Moscow). Med. Radiol.; 17: No. 5, 64-6(May 1972). (In Russian).

A formula for choosing energy of an activating radiation source is deduced. Calculations are made according to the formula and regularities governing changes of the $h\nu_0$ value occurring parallel with variations of the atomic number Z, scattering angle of the primary radiation θ, energy resolution $\Delta E'$ are ascertained, this making it possible by calculating one value for $h\nu_0$ according to the formula to obtain fairly quickly and sufficiently accurately ($\approx 5\%$) the other $h\nu_0$ values. For example, with $\theta < 90°$, having found according to the formula the $h\nu_0$ value for $Z = 20$, simple interpolation suffices to obtain the other $h\nu_0$ values with $20 \leq Z \leq 90$. In investigations with an inactive tag, the estimation of $h\nu_0$ enables one to choose the energy for the activating radiation sources in a well-grounded and simple fashion. (auth)

Shielding Calculations and Theory

Refer also to abstracts 43541, 43948, and 45013.

44508 DETERMINATION OF THE ADEQUACY OF NEUTRON AND SECONDARY GAMMA-RAY PRODUCTION CROSS SECTIONS OF NITROGEN BASED ON THE COMPARISON OF CALCULATIONS WITH INTEGERAL EXPERIMENTS. Straker, E. A. (Science Applications, Inc., Huntsville, Ala.). Trans. Amer. Nucl. Soc.; 15: No. 1, 528-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44509 CROSS-SECTION SENSITIVITY CALCULATIONS FOR THE LLL PULSED SPHERE EXPERIMENTS. Cramer, S. N.; Roussin, R. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 529-30(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44510 USE OF THE MORSE MONTE CARLO CODE TO SOLVE SHIELDING AND CRITICALITY PROBLEMS OF SPENT FUEL CASKS. Morrison, G. W. (Oak Ridge National Lab., Tenn.); Odegaarden, R. H.; Straker, E. A. Trans. Amer. Nucl. Soc.; 15: No. 1, 547-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44511 MONTE CARLO BUILDUP FACTOR CALCULATIONS INCLUDING THE CONTRIBUTION OF BREMSSTRAHLUNG. Kuspa, John Paul; Tsoulfanidis, Nick. Trans. Amer. Nucl. Soc.; 15: No. 1, 553-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44512 COUPLED TRANSPORT CALCULATIONS THROUGH CONCRETE FOR HIGH-ENERGY NEUTRON SOURCES. Roussin, R. W.; Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 561-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44513 BUILDUP FACTOR FORMULA FOR MULTILAYERED SHIELDS. Rohach, Alfred F.; Koo, Norman H. (Iowa State Univ., Ames). Trans. Amer. Nucl. Soc.; 15: No. 1, 575-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44514 DETERMINATION OF PHOTON KERNELS FROM INCIDENT BREMSSTRAHLUNG RADIATION. Rodriguez, L. F.; Shapiro, A. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 1, 579(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44515 MULTIDIMENSIONAL EFFECTS IN ELECTRON SHIELDING. Gordon, James D. (TRW Systems Group, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 582-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44516 YADERNOE IZLUCHENIE I ZASHCHITA V KOSMOSE. (Nuclear Radiation and Protection in Outer Space). Khaffner, Dzh. Mowcow; Atomizdat (1971). 320p.

Properties of nuclear radiation in outer space, their effects on cosmonauts, and construction materials of spacecraft are discussed. Individual chapters deal with, respectively, the sun's corpuscular radiation, galactic cosmic radiation, the radiation belts of the Earth, and attenuation of charged-particle fluxes, neutrons, and γ radiation. Computer programs for calculating radiation shielding are listed: about 46 from the Argonne Information Center, and over 20 from the Oak Ridge Information Center. The magnitude of radiation doses in outer space from different sources is discussed, and the radiation aspects of space flight are evaluated in this light. (710 references) (K.S.W.)

44517 CONCRETE FOR NUCLEAR RADIATION SHIELDING. Radhamohan, S. K.; Sridharrao, J. K. (Indian Inst. of Tech., Kanpur). Cem. Concr.; 10: No. 1, 45-7(1969).

Salient features of concrete for nuclear radiation shielding are reviewed and compared with other materials for use in the design of nuclear reactors particle accelerators, and fallout-resistant structures against the effects of nuclear weapons. Properties of high-density concrete using high-density aggregates are reviewed, considering different types of aggregates, types of cement, and tests for characteristic properties of various types of concrete and mortar. Principles of the design of radiation shielding structures for attenuation of γ rays and neutrons are described and graphs are drawn. A critical note on areas for further development is made. (47 references) (Indian Sci. Abstr.)

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts 43119, 43122, 43123, and 44937.

44518 (COO-1629-31) THERMAL MEASUREMENTS ON SOLIDS BELOW 1 K. Progress Report No. 6. Weinstock, Harold (Illinois Inst. of Tech., Chicago. Dept. of Physics). Feb 1972. Contract AT(11-1)-1629. 21p. Dep. NTIS.

CARBON—electric conductivity of films of, at 3 to 900°K
GRAPHITE—thermal conductivity of pyrolytic, theory of lattice
LEAD—thermal conductivity of films of, effects of superconducting transition and magnetic field on
MAGNESIUM OXIDES—radiation effects on low-temperature thermal conductivity of, neutron
NEUTRONS—effects on thermal conductivity of magnesia at low temperatures (D.L.C.)

44519 (N-72-19734) ION BOMBARDMENT AND ITS EFFECTS ON THE OPTICAL PROPERTIES OF METALS. Anderson, Donald L. (National Aeronautics and Space Administration, Moffett Field, Calif. Ames Research Center). [1964]. 20p. (NASA-TM-X-67660). NTIS.

An experimental program to evaluate the change in total hemispherical emittance and solar absorptance of engineering metals used on spacecraft and in spacecraft instrumentation systems is presented. Three materials, titanium alloy, pure aluminum, and electrolytic copper, were used in the experiment. Results show that emittance, absorptance, and α/ϵ ratio of the materials were changed by ion bombardment. The time before the change occurs depends upon the material used, the intensity of bombardment, and the environment assumed. (STAR)

44520 LATTICE AND DISLOCATION MECHANISM OF COLLOID FORMATION IN ALKALI HALIDE CRYSTALS. Tsal, N. A.; Didyk, R. I. (Lvov State Univ.). Phys. Status Solidi (b); 51: No. 2, 891-9(1 Jun 1972).

A thorough investigation of F → X conversion in NaCl crystals heat treated at different temperatures following high-temperature x irradiation made it possible to conclude that there exist two types of X centers that differ in the formation sites. X centers localized in the crystal lattice (X_L centers) are responsible for the absorption band with the peak position at 620 nm, while x centers responsible for the 550-nm band are localized along dislocation lines (X_D centers). (auth)

44521 SOUND EXCITATION IN METALS BY ELECTRONS, POSITRONS, AND PHOTONS. Borshkovskii, I. A.; Volovik, V. D.; Grishaev, I. A.; (and others) (Kharkov State Univ.). Phys. Lett.; 40A: No. 2, 97-8(3 Jul 1972).

Sound excitations in metals by electrons, positrons and bremsstrahlung photons at $E_0 = 620$ MeV are studied. The main contribution to the production of an acoustic signal in metals is shown to be given by secondary electrons. (auth)

44522 DYNAMIC EFFECT IN METALS PENETRATED BY RELATIVISTIC BEAMS. Akhiezer, I. A.; Lazurik-Eltsufin, V. T. (Kharkov State Univ.). Phys. Lett.; 40A: No. 2, 155-6 (3 Jul 1972).

Mechanical forces in metals caused by relativistic electron beams are studied. The forces are shown to be proportional to $Z^2\rho$ and practically independent of the beam energy (Z and ρ are the atomic number and mass density of the target respectively). (auth)

44523 DECHANNELING OF FAST LIGHT IONS. Beloshitskii, V. V.; Bulgakov, Yu. V.; Kumakhov, M. A. (Inst. of Nuclear Physics, Moscow). Phys. Lett.; 40A: No. 2, 181-2(3 Jul 1972).

The dechanneling function was obtained experimentally for 7.15-MeV helium ions in axial ⟨110⟩ channel in Si. The experimental data on multiple scattering of channeled ions are compared to theoretical calculations based on the Fokker—Planck kinetic equation. The main factors responsible for the escape of ions from planar channels were found. (auth)

44524 FIELD-ION MICROSCOPY OF TUNGSTEN BOMBARDED BY LOW-ENERGY ARGON IONS. Gregov, B.; Lawson, R. P. W. (Univ. of Alberta, Edmonton). Can. J. Phys.; 50: No. 8, 791-7(15 Apr 1972).

The investigation of low-energy ion radiation damage in tungsten by field-ion microscopy is discussed. An experimental arrangement is described in which prepared field-ion microscope specimens may be bombarded in situ by ions from an ion gun. The background pressure in the range of 10^{-11} torr allows bombardment to be carried out while the high voltage is off. Results of specimens bombarded with Ar^+ ions in the range 150 to 450 eV at 63°K are described. Diffusion of self-interstitials upon annealing the irradiated specimen from 63 to 78°K was observed. Besides point defects, clusters of vacancies and interstitials were observed on specimens bombarded with 400- and 450-eV Ar^+ ions. The irradiation-induced defect density on the side of the microscope specimen facing the ion beam is approximately double that on the far side. (auth)

44525 ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED DIAMOND. Whippey, P. W. (Univ. of Western Ontario, London). Can. J. Phys.; 50: No. 8, 803-12(15 Apr 1972).

A comprehensive study was made of electron spin resonance in neutron-irradiated diamond. The main feature is the A spectrum, a broad intense line centered at $g = 2.00$. The concentration of A centers is proportional to dose for doses up to 5×10^{19} n cm^{-2}, when the concentration is 10^{21} centers cm^{-3}. At least three centers contribute to the A spectrum. The anisotropic B and C spectra are observed in specimens irradiated to doses less than 10^{19} n cm^{-2}. The anisotropic spectrum D is shown to be an annealing product. The spin Hamiltonian is $H = g\beta B.S + DS_z^2 + E(S_x^2 - S_y^2)$ either with $D = (1.04 \pm 0.01) \times 10^{-2}$ cm^{-1}, $E = (2.7 \pm 0.2) \times 10^{-4}$ cm^{-1}, $S = 1$, $g = 2.00$ or $D = 0.52 \times 10^{-2}$ cm^{-1}, $E = 1.3 \times 10^{-4}$ cm^{-1}, $S = 3/2$, $g = 2.00$. The A, B, and C spectra have been observed in electron-irradiated diamond by Owen. The models proposed here are in broad agreement with his proposals. (auth)

44526 CHARGE-STATE EFFECTS IN DISPLACEMENT DAMAGE. Corbett, J. W.; Bourgoin, J. C. (State Univ. of New York, Albany). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 11-20(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Charge-state effects in displacement damage in covalent semiconductors are reviewed. Specifically, the influence on defect production mechanisms, configurations, mobility, annealing kinetics, interaction, and dissociation are discussed. The recent theoretical work on the split-interstitial is mentioned, as is the new athermal migration mechanism. (15 figures, 98 references) (auth)

44527 NEUTRON-INDUCED METALLIC SPIKE ZONES IN GaAs. McNichols, J. L. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.); Berg, N. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 21-30(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

The electrical properties of semiconductors containing metallic spikes are explored. The metallic zones are shown to act as deep potential wells which trap carriers from the host semiconductor energy bands. The component of mobility associated with carrier scattering from the depletion region surrounding charged spikes is estimated as a function of temperature, including the temperature dependence of the trapped charge. Hall measurement data taken before and after neutron irradiation of n-type GaAs are compared with theory and good agreement is obtained. It is proposed that the high-field trapping and slow release of electrons observed in neutron-irradiated Gunn diodes is associated with the presence of metallic spikes. Hot electrons in high-field domains penetrate the electrostatic barrier and are trapped within the spikes. When the low-field condition is restored, excess electrons return to the host semiconductor matrix. The rate of escape of excess electrons is estimated from considerations of the processes of emission over and tunneling through the electrostatic barrier. Measurements of the temperature-dependent decay rates of the excess charge are obtained from neutron-irradiated Gunn diodes. Two decay rates were obtained at each temperature. The shorter decay time shows a temperature dependence consistent with a quantum tunneling mechanism. The longer decay time shows a stronger temperature dependence which is in qualitative agreement with emission of electrons over the barrier. It is concluded that the predictions of the metallic spike model are in accord with the observed electrical property changes in neutron-irradiated GaAs, and that the metallic spike model is the only model thus far studied that is consistent with both electrical and infrared property changes. (auth)

44528 RADIATION-INDUCED CHANGES IN THE PHOTOLUMINESCENCE SPECTRA OF CADMIUM SULFIDE. Randolph, L. P. (Harry Diamond Labs., Washington, D. C.); Oswald, R. B.

Jr.; Thorpe, A. N. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 31-9(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Photoluminescence spectra of irradiated CdS were measured over a wavelength range from 4800 to 5400 Å. Gamma-ray induced changes in the 4.2°K photoluminescence spectra show a reduction in intensity of bound exciton transitions I_1 and I_5 and edge emission in contrast to an enhancement of a spectral line at 4867.2 Å (I_R). These changes were measured for irradiation temperatures of 300, 78, and 4.2°K. The 78°K photoluminescence shows that exciton emission is more sensitive to radiation-induced changes than is edge emission. Thermal annealing takes place below room temperature, particularly in the 140 to 260°K region. The sensitivity of the luminescence intensity to radiation exposure only at cryogenic temperature and the thermal annealing of the radiation-induced changes are attributed to the mobility of defects at and below room temperature. Studies of polarized luminescence and the temperature dependence of the luminescence show that I_R is like the I_2 exciton lines. Optical quenching at 4.2°K indicates that the defect responsible for I_R is sensitive to its charge state. The results of electron exposures at various energies at approximately 90°K show that I_R is associated with a sulfur defect, possibly S_I. (auth)

44529 RADIATION-INDUCED LASER ACTION IN CdSe. Arora, B. M. (Univ. of Illinois, Urbana); Ahlburn, B. T.; Compton, W. D. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 40-4(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Laser emission of CdSe excited by Ga(AsP) laser diode was studied near liquid helium temperature both before and after irradiation with fast neutrons. Irradiation introduces new laser peaks at ~6895 Å, ~6905 Å, and ~6924 Å, which are situated at longer wavelengths compared to the peaks observed before irradiation. The laser peak at ~6905 Å can be associated with the strong spontaneous emission that is observed at the same wavelength after irradiation. These results are interpreted in terms of the recombination of excitons bound to the defects introduced by irradiation. (auth)

44530 CARRIER-REMOVAL EFFECTS IN NEUTRON-IRRADIATED LITHIUM-DOPED SILICON. Kimerling, L. C.; Drevinsky, P. J. (Air Force Cambridge Research Labs., Bedford, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 60-8(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Carrier removal effects in n-type silicon as a result of neutron irradiation and subsequent heat treatment were monitored by Hall effect and conductivity measurements at a temperature of 275°K. Samples of float-zoned, crucible, and Lopex grown (ρ = 100 to 0.3 Ω-cm) phosphorus-doped silicon and float-zoned and Lopex grown (ρ = 30 to 0.3 Ω-cm) lithium-doped silicon were irradiated at ambient temperature with ~5-MeV neutrons and, subsequently, heat treated between 20 and 200°C. The carrier removal rates for the lithium-doped samples, 7 to 75 cm^{-1}, were significantly higher than the removal rates observed in the conventionally doped samples, 6 to 12 cm^{-1}. In addition, the lithium-doped material exhibited a strong dependence of removal rate on dopant concentration, whereas the data for the conventional samples were relatively independent of dopant level. Upon subsequent heat treatment, the lithium-doped samples showed continued carrier removal, while the phosphorus-doped samples tended to recover to a preirradiation condition. The enhanced carrier removal in the lithium-doped material was found to be consistent with the removal of positively charged lithium donors from a state of electrical activity by ion drift to the negatively charged defect cluster. Relevant parameters yielded by this model are: a defect cluster radius of 300 Å, a cluster charge of −150e, and an effective capture radius for the lithium drift of 2500 Å. The continued carrier removal in the heat-treated, lithium-doped silicon follows kinetics expected for the precipitation of lithium at the neutron-produced defect cluster sites through a diffusion-limited process. The model yields an activation energy of ~0.62 eV which compares well with the ~0.66 eV required for the diffusion of lithium. In addition, the precipitation site density derived from the model shows a one-to-one correspondence with the defect cluster concentration. The reported recovery of minority-carrier lifetime degradation from neutron irradiation of lithium-doped silicon occurs at the same temperatures as the continued carrier removal and exhibits the same kinetics. The total carrier removal rate (irradiation + heat-treatment to 200°C) observed is ~120 cm^{-1}. Thus, in the order of 1000 lithium atoms are required to neutralize the recombination properties of a defect cluster induced by 5-MeV neutrons. (auth)

44531 CALCULATION OF REVERSE ANNEALING IN NEUTRON-DAMAGED p-TYPE SILICON. Schwegler, E. C. (General Dynamics, Fort Worth, Tex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 69-77(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A calculation of the reverse annealing process in neutron-burst irradiated p-type silicon at 300°K was performed, utilizing a variation of the equilibrium cluster theory of Gregory. Material conditions which were considered included 1, 10, and 100 Ω-cm material with an injection ratio of 10^{-6}, and 1 Ω-cm material with injection ratios of 10^{-7} and 10^{-8}. This calculation demonstrated the relationship between the peak and time of occurrence of the damage constant versus time curve and the material resistivity and injection level. It was also shown that the reverse annealing rate depends upon the capture rate of defects in the cluster, rather than the rate of transport of defects from the depletion region to the cluster. These carrier-capture rates were such that the forward annealing process usually began before the clusters reached charge saturation. Finally, it was concluded that an injected minority carrier pulse lasting less than 5×10^{-6} sec after burst will not appreciably affect the reverse annealing process. (auth)

44532 DEFECT STRUCTURE AND IRRADIATION BEHAVIOR OF NONCRYSTALLINE SiO_2. Revesz, A. G. (COMSAT Labs., Clarksburg, Md.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 113-16(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Various phenomena occurring during ionizing or particle irradiation of vitreous silica and Si/SiO_2 interface structures are explained. Densification and changes in bond polarizability are due to the basic trend of maximizing π-bonding between Si and O atoms with minimum bond strain. Hole trapping in SiO_2, as exhibited, e.g., in irradiated MOS devices, is an intrinsic property of the Si−O bond. Irradiation generates trivalent Si and nonbridging O defects. These interact with impurities, especially SiOH and SiH groups, as well as with interstitial H. These defects determine the radiation behavior of vitreous silica and $Si-SiO_2$ interfaces, as well as the stability of MOS devices. (auth)

44533 PHOTOEMISSION FROM POLYMERS. Hai, F.; Bernstein, M. J. (Aerospace Corp., El Segundo, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 178-84 (Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

An experimental study was made of photoemission from several polymers, including polyethylene, kapton, teflon, and polyvinyl chloride,, under irradiation by 15−25 keV photons. The emission intensities from these plastics were compared to those from several conductors, ranging from carbon to tantalum, and from other insulators, such as glass and mica. For all these materials, the relative magnitude of photoemission was found to be mainly proportional to the photoelectric absorption coefficient. Under this pulsed irradiation, the insulators emitted as conductors when backed by conducting sheets but exhibited reduced emission associated with trapped charges when isolated. (auth)

44534 RADIATION DAMAGE IN OXIDES AND OTHER MATERIALS. Sibley, W. A. (Oklahoma State Univ., Stillwater). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 273-80(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

A review of radiation-damage processes in MgO and MgF_2 is presented. The damage processes are discussed in terms of their efficiency and energy dependence. The damage process in MgF_2 is due to radiolysis which is a much more efficient process than that due to elastic collisions between the incident radiation and the lattice ions. The latter process is dominant in MgO and ZnO and radiolysis apparently does not occur in these materials. 10 figures, 23 references. (auth)

44535 RADIATION-INDUCED CONDUCTIVITY IN POLYMERS: POLY-N-VINYLCARBAZOLE. Hughes, Robert C. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 6, 281-7(Dec 1971).

From Annual conference on nuclear and space radiation effects; Durham, N. H. (20 Jul 1971). See CONF-710709.

Experimental evidence is given which indicates that the yield of charge carriers excited by a given dose of x rays in thin films of poly-N-vinylcarbazole (PVK) is dominated by geminate (initial) recombination of the ion pairs. The yield as a function of applied field gives a very good fit to the theory of initial recombination developed for gases by Onsager. Two competing mechanisms, the

Poole–Frenkel effect and track recombination, may be rejected on the basis of the field dependence. A comparison of the charge transients in PVK with other organic materials is given along with a discussion of the possibility of trap modulation of the mobility in PVK. The role of three different kinds of carrier recombination, bulk, track, and geminate, is described in terms of the experimental results expected for each of them. (auth)

44536 DIFFRACTION MAXIMA OF DYNAMIC ORIGIN. Belyakov, V. A. Sov. Phys.-Solid State (Engl. Transl.); 13: No. 11, 2789-91(May 1972).

Translated from Fiz. Tverd. Tela; 13: No. 11, 3320-2(Nov 1971).

It is shown that diffraction maxima due to the anisotropy of the thermal vibrations of atoms, and forbidden by the space group of the crystal, may occur during scattering of x rays and other types of radiation by crystals. Examples are given of structure for which forbidden diffraction maxima of this type exist, and certain aspects of their experimental detection are discussed briefly. (auth)

44537 CRYOSTAT FOR OPTICAL AND ELECTRICAL MEASUREMENTS OF IRRADIATION EFFECTS ON SOLIDS. Yoshida, Toshio; Oka, Takashi; Kitagawa, Michiharu; Fujino, Takahiro; Shono, Yoshihiko. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 54-6(1971).

A cryostat convenient for study of effects of electrons of energy below 1 MeV on solids is described. It permits irradiation near liquid-nitrogen temperature and optical and electrical measurements during and after irradiation. The sample temperature during irradiation is discussed. The electron-irradiation effects on the thermally stimulated current in a CdS single crystal are described as a typical experimental result obtained by the cryostat. (auth)

44538 SCATTERING CENTERS INDUCED BY ELECTRON IRRADIATION IN CdS. Kitagawa, Michiharu; Yoshida, Toshio; Shono, Yoshihiko. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 57-61(1971).

The effects of fast-electron irradiation and subsequent thermal annealing at 295°K on high-conductivity CdS were studied through measurements of the carrier concentration and the Hall mobility. Both carrier concentration and mobility are considerably decreased by irradiation. The irradiation effects cannot be completely removed even with annealing for sufficiently long time. The variation in density of charged scattering centers, which was calculated from the change in mobility, indicates that at least two kinds of trap-type defects and two kinds of donor-type defects are produced by irradiation. One kind of trap-type defects is rapidly decreased in density with 295°K annealing, and one kind of donor-type defects is gradually decreased. All of the energy levels discussed in this paper are estimated to be located in the range $E_c - 0.05$ eV to $E_c - 0.15$ eV. (auth)

44539 IMPROVED METHOD FOR MEASURING FAST-ELECTRON-IRRADIATION EFFECTS ON LUMINESCENCE UNDER IRRADIATION. Fujino, Takahiro; Yoshida, Toshio; Oka, Takashi; Shono, Yoshihiko. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 62-4(1971).

A method to measure irradiation effects on luminescent properties of semiconductors under irradiation with fast electrons is described. A sample to be investigated is irradiated with the electron beam chopped periodically by a pulsed magnetic field, and the resultant luminescent emission is measured by means of a photosensor and lock-in amplifier. A beam-scanning system is also described, which provides uniform irradiation. A luminescence spectrum of a CdS single crystal under irradiation is presented. (auth)

44540 BAND MODEL OF OPTICALLY-INDUCED CHARGE TRANSFERS IN ELECTRON-IRRADIATED ZnS. Shono, Yoshihiko; Yoshida, Toshio; Kitagawa, Michiharu. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 65-8(1971).

A band model is constructed to explain the quenching behavior of an ESR signal H ($g_{||} = 2.0565$ and $g_{\perp} = 2.0266$) observed in electron-irradiated ZnS, under illumination with 1.8-eV light following irradiation with various-energy light. The band model has two kinds of electron-trapping levels, four kinds of hole-trapping levels, and a recombination level. Three kinds of hole-trapping levels are due to Cu^{2+} centers, Fe^{3+} centers, and the centers responsible for the ESR signal H. The capture cross section of the recombination center for a hole in the valence band is assumed to be large when the recombination center is trapping an electron. The experimental results can be interpreted in terms of this band model. (auth)

44541 ELECTRONIC AND IONIC CONTRIBUTIONS TO THE ROOM TEMPERATURE D. C. CONDUCTIVITY OF γ-IRRADIATED NaCl AND NaCl (Ca). Sanchez, C. (Junta de Energia Nuclear, Madrid). J. Phys. Chem. Solids; 33: No. 8, 1611-18(Aug 1972).

The dc electrical conductivity of γ-irradiated NaCl and NaCl (3.7×10^{-4} mol Ca^{+2}) was studied between room temperature (RT) and 70°C. It was found that γ rays introduce a transient electronic component in the dc conductivity of NaCl. The current due to this component, measured ~20 min after irradiation, is 10 to 100 times (depending on γ dose) higher than the ionic current. It decays very slowly with time and at RT exhausts in ~10 hr. On heating the irradiated samples up to 70°C, a thermally stimulated current peak due to the electronic component appears at 48°C. On the other hand, the conductivity of γ-irradiated NaCl (Ca) is purely ionic. It is proposed that shallow traps existing in the as received crystals are responsible for that electronic component. Gamma irradiation reduced the ionic current of both pure and doped NaCl. At RT for doses $\gtrsim 2.6 \times 10^6$ R, the ionic current of the irradiated samples is 80% (NaCl) and 15% (NaCl: Ca) of the value prior to irradiation. (auth)

44542 RADIATION CENTERS ARISING FROM THE BOMBARDMENT OF DEHYDRATED GERMANIUM SURFACES BY LOW ENERGY He^+ IONS. Litovchenko, V. G.; Lysenko, V. S.; Dubchak, A. P. (Inst. of Semiconductors, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 8, 1364-6(Aug 1971). (In Russian).

Germanium surfaces were preconditioned by dehydration and then bombarded with He^+ ions of energies 450 and ~10^4 eV. Dehydration obviated the desorption during bombardment of moisture or hydroxyl ions. It was established that the H_2O and OH that still remained on the Ge surfaces were weakly migrating and did not form a continuous layer on the boundaries where defect centers were generated. Bombardment of the surface resulted in a large increase in S, the velocity of surface recombination, due to the formation of new centers near the surface. (K.S.W.)

44543 OPTICAL ABSORPTION INDUCED BY PROTON IRRADIATION IN MgO. Seiyama, Takeyoshi; Yoshida, Toshio; Hiraoka, Eiichi. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 69-70(1971).

It was found that prominent optical absorption bands at wavelengths of 353 and 573 nm are introduced in magnesium oxide single crystals by irradiation by protons of energy 0.75 MeV. The bands change in intensity in different fashion as a function of total dose of irradiated protons. These two bands are thought to be identical with the bands introduced by neutron irradiation. (auth)

44544 EFFECT OF A LOW ENERGY ION BOMBARDMENT ON THE CHARACTERISTICS OF SCHOTTKY BARRIERS. Guetin, P.; Schreder, G. (Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). pp 80-5 of International Colloquium on the Application of Vacuum Techniques to the Semiconductor Industry Electronic and Microelectronic Components. AVISEM 71. Paris; Societe Francaise des Ingenieurs et Techniciens du Vide (1971). (In French). (CONF-710932-7).

From third international symposium on the application of vacuum techniques in semiconductor industry, electronic components, and microelectronics; Versailles, France (13 Sep 1971).

The effects of rare gas ion bombardment (Ar, Ne, Kr) at energies between 30 and 200 eV on the properties of metal/n–GaAs junctions were investigated. The experiments were effected at $T \leq 4.2$°K with $n = 5.4 \times 10^{-8}$ cm^{-3} GaAs (pure tunneling region). Two modes of operation are considered: low-energy operation ($E \sim 50$ eV); high-energy operation ($E \geq 100$ eV). The first mode of operation corresponds to, at least, a partial cleaning of the surface. At energies in excess of 1000 eV, the ion bombardment produces a change in the nature of the barrier. A sharp increase in the differential resistance (dV/dI) and a modification in the behavior of this function with bias voltage are observed; reproducible structures also occur on the d^2I/dV^2 curves. (France)

44545 BLOCH WAVE CHANNELING AND EXTENDED LINDHARD'S THEORY. Kubota, Y.; Ohtsuki, Y.-H. (Waseda Univ., Tokyo). Phys. Status Solidi (b); 52: No. 1, 271-4(1 Jul 1972).

Lindhard's theory for ion channeling is extended to a quantum-mechanical formulation, and the "Bloch wave channeling" is interpreted with the planar continuum potential including inelastic scattering. (auth)

44546 LATTICE PARAMETER CHANGE IN DIAMOND IRRADIATED BY FAST ELECTRONS AT VARIOUS TEMPERATURES. Konobeevskii, S. T.; Takibaev, Zh. S.; Abdullin, A. G.; Grishchenko, V. F. (Kazakh State Univ., Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 202: No. 3, 560-1(21 Jan 1972). (In Russian).

The effect of high-energy electrons on the lattice parameters of diamond was investigated by exposing natural diamond powders to 2.3-MeV electrons in a high-current linear accelerator, while being cooled with water. The irradiation temperatures were 236 and 80°C, respectively. X-ray examination showed that the changes in the lattice period which occurred depended on the electron dose, approximately as $\Delta a/a : I = 0.11 \times 10^{21}$ el/cm^2. This is approximately 70 times less than the effectiveness of neutrons. The change in irradiation temperature did not alter the stability of the induced defects. (K.S.W.)

44547 ION BOMBARDMENT AND IMPLANTATION AND THEIR APPLICATION TO THIN FILMS. Stroud, P. T. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Thin Solid Films; 11: No. 1, 1-26(Jul 1972).

A review is presented of ion implantation and its effects on noncrystalline solids in thin-film form. After a brief account of collision phenomena and implantation equipment, ion effects on the structures of films are discussed; it is shown that changes in the degree of order in films can be attributed to ion impact. Effects on electrical properties of films and possible applications to thin-film passive components are next considered. (20 figures, 71 references) (D.L.C.)

44548 COMMENT ON "SHORT-TERM ANNEAL OF 30-MeV ELECTRON DAMAGE IN HIGH-PURITY n-TYPE SILICON." Srour, J. R. (Northrop Corporate Labs., Hawthorne, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 897-8(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Recently, Mallon and Naber (IEEE Trans. Nucl. Sci., 17: 123 (1970)) reported studies of short-term annealing in 30-MeV electron-irradiated high-resistivity n-type silicon. Here it is demonstrated that the minority-carrier lifetime recovery they observed is consistent with a process involving the motion of neutral vacancies. (auth)

44549 INVESTIGATION OF DOUBLE INJECTION IN SEMI-INSULATORS WITH INJECTION-DEPENDENT CARRIER LIFETIMES IN THE PRESENCE OF ELECTRON TRAPPING, USING NEUTRON-IRRADIATED SILICON AS A CASE IN POINT. Sergent, Jerry Eldon. Cincinnati; Univ. of Cincinnati (1971). 253p. University Microfilms Order No. 72-16,558.

Thesis.

Double injection into semi-insulators in the presence of defect states at several energy levels is considered. The model is that of a semi-insulator with one recombination center completely filled with electrons and one electron trap with an arbitrary ratio of electron-occupied and unoccupied states. A complete analytical solution is developed using the method of regional approximation. A method of interpolation is developed that yields a complete analytical solution to an arbitrary degree of accuracy whereas, before, only an approximate solution was available for the simpler case of no trapping. During the course of development of the solution, an expression is derived for the voltage at which the hole-current flow begins to become significant, beyond which point a negative resistance region is shown to exist. This voltage, the so-called "threshold voltage," is shown to be strongly temperature-dependent, the threshold voltage decreasing rapidly with temperature, unlike the expression developed for previous models which did not consider trapping. The temperature dependence is due to the ratio of unoccupied to occupied traps, which is also dependent on temperature. These occupied traps are shown to increase the lifetime of the holes by allowing more holes to be injected at a given voltage. A numerical solution of the V–I characteristic is calculated and is seen to verify the analytical and experimental results and lend credence to the assumption of neutrality near the anode at relatively high levels of injection, an assumption used in obtaining the expression for the threshold voltage. Experimental devices fabricated from neutron-irradiated silicon are constructed and V–I characteristics for these devices are obtained. The properties of the material are analyzed, and it is verified that the material meets the standards set forth in the premise (a semi-insulator with defect states at several energy levels). The devices thus fabricated and tested are observed to show a strong qualitative agreement with the theory, the threshold voltage decreasing as temperature is increased, being followed by a negative-resistance region. Strong evidence is also given that suggests several defect states are participating in the recombination process, as opposed to the single midgap level suggested by earlier investigators. During the course of the experimental work, several devices are observed to yield both a TFL characteristic and a negative-resistance region. (Diss. Abstr. Int., B)

44550 VOLUME RELAXATION ASSOCIATED WITH THE INTERSTITIAL ION IN X-IRRADIATED KBr. Cunningham, Stephen Stewart. Princeton, N. J.; Princeton Univ. (1971). 112p. University Microfilms Order No. 72-14,141.

Thesis.

The volume relaxation associated with the interstitial ion in KBr was measured during x-irradiation-induced growth at 9.5 and 16°K. In addition, the volume relaxation was measured during isothermal annealing at 11 and 17°K, and the annealing results were equal to the growth results at 9.5 and 16°K, respectively. The agreement of growth and annealing measurements indicates that the α and I defects are created and annihilated as complementary Frenkel pairs. There is an apparent temperature dependence in the measured value of the I-center volume relaxation as the result at 16°K is nearly twice as large as the 9.5°K value. Since a complete theoretical model of the volume relaxation associated with crystal defects does not exist, it cannot be shown whether this measured difference is due to an actual change in the magnitude of the relaxation or to some additional complication. F-band optical bleaching experiments were also performed to try to isolate the contributions of the various types of radiation-induced defects to the total measured relaxation. Irradiation with F-band light caused a great decrease in the F, and "H"-band concentrations, but no measurable change in the concentration of the I band or the measured volume change of the sample. Bleaching caused a slight increase in the α-band concentration, but this change was many times less than the F-band decrease. The lack of a one-to-one correspondence between the F and α bands during bleaching suggested that some negative-ion vacancies did not give rise to α-band optical absorption. A survey of experimental evidence, and a theoretical calculation based on a perturbed exciton model for the α center is presented to suggest that the observed α band is not due solely to an isolated negative ion vacancy, but to a negative ion vacancy associated with a nearby negative charge. Since the F-band bleaching results have indicated the possibility of "uncounted" defects, a model based on the occurrence of this type of defect can be proposed. The measured difference in the volume relaxation of the I-center could be explained if the counting of induced defects was in error due to the presence of optically "invisible" defects. It is proposed that isolated negative ion vacancies and impurity-associated interstitial ions could contribute to the measured volume relaxation but not be counted as simple α or I defects. The occurrence of a larger number of uncounted defects at 16°K than at 9.5°K would account for the apparent temperature dependence in the I-center volume relaxation. (Diss. Abstr. Int., B)

44551 STRUCTURE AND MOTIONS OF THE H_A (Li^+)-TYPE $BrCl^-$ AND ICl^- CENTERS IN DOPED KCl. Schoemaker, Dirk; Shirkey, Charles T. (Argonne National Lab., Ill.). Phys. Rev., B; 6: No. 4, 1562-72(15 Aug 1972).

The H_A(Li^+)-type $BrCl^-$ center is an interstitial center, which can be produced by ionizing irradiation and suitable thermal and optical treatment, in KCl crystals strongly doped (~1 wt.%) with Li^+ and Br^- ions. As the name implies, its structure is very similar to that of the H_A(Li^+) center in KCl : Li^+. The electron paramagnetic resonance (EPR) analysis at 77°K shows that it consists of a $BrCl^-$-molecule ion, occupying a single negative-ion site, next to a substitutional Li^+ ion. The $BrCl^-$ internuclear axis makes a 25° angle with ⟨100⟩ in a {110} plane, and the molecular bond is bent by about 8°. The center is formed when a mobile, interstitial, chlorine atom is stabilized by a pair of substitutional Li^+ and Br^- impurity ions which are nearest neighbors of one another. The H_A(Li^+)-type $BrCl^-$ possesses a thermally activated ($E \cong 0.093$ eV) pyramidal motion of $C_{4\nu}$ symmetry around a given ⟨100⟩, and motionally averaged EPR spectra are observed at 200°K. In contrast to the H_A(Li^+) center, it does not appear to possess a restricted interstitial motion of $C_{3\nu}$ symmetry around ⟨111⟩. It is concluded that the Cl side of the $BrCl^-$ molecule is closer to the Li^+ ion, and that the bending of the $BrCl^-$ bond is toward the Li^+ ion. This conclusion permits a more refined description of the H_A(Li^+) center model: The Cl_2^- bond there too is bent toward the Li^+ ion. Results for the H_A(Li^+)-type ICl^- center in KCl: (Li^+, I^-) are also given. Its properties are very similar to those of the H_A(Li^+)-type $BrCl^-$ center. (auth)

44552 THIRD-ORDER ELASTIC CONSTANTS OF NaF. Bensch, W. A. (Worcester Polytechnic Inst., Mass.). Phys. Rev., B; 6: No. 4, 1504-9(15 Aug 1972).

The complete set of third-order elastic constants for single crystals of NaF was determined from the hydrostatic-pressure and uniaxial-stress derivatives of natural-sound velocities measured with a two-crystal ultrasonic-interference technique. There appeared to be no dislocation motion during the uniaxial measurements since changes in the natural sound velocities with stress were linear, and data recorded before and after a γ irradiation agreed within experimental error. The Cauchy relations were not satisfied, revealing that noncentral forces between the ions are appreciable. Calculations of the elastic constants were carried out according to the Born model. The high-temperature Grueneisen constant and thermal-expansion coefficient were determined from the elasticity data and the latter compared with experimental results. (auth)

44553 HIGH-POWER ELECTRON BEAM DEPOSITION STUDIES ON ALUMINUM AND GRAPHITE. Farber, Milton; Robin, James E.; Srivastava, R. D. (Space Sciences, Inc., Monrovia, Calif.). J. Appl. Phys.; 43: No. 8, 3313-17(Aug 1972).

The deposition phenomena produced by a 25 to 135-MW electron beam were studied experimentally on aluminum and graphite targets. Large concentrations of multicharged ions of Al and C were produced. The parameters which were obtained quantitatively included momentum transferred to the target by the blow-off material, total mass loss, species velocities, radiation losses, and enthalpy rise in the targer materials. From these data, the energies of sublimation for aluminum and graphite were calculated, together with the distribution between spall and vapor species in the blow off. Some of the results are compared with laser data. (auth)

44554 LATTICE LOCATION BY CHANNELING ANGULAR DISTRIBUTIONS: Bi IMPLANTED IN Si. Picraux, S. T. (Sandia Labs., Albuquerque, N. Mex.); Brown, W. L.; Gibson, W. M. Phys. Rev., B; 6: No. 4, 1382-94(15 Aug 1972).

Measurements of 1-MeV He^+ channeling were used to study the lattice location of ion-implanted Bi in Si. Single-alignment $\langle 110 \rangle$ and $\langle 111 \rangle$ angular distributions for He scattering from both the Si and Bi atoms at the same depth were measured as a function of implant conditions at 296 and 80°K. Double-alignment angular distributions were also measured for uniaxial and 90° biaxial channeling along $\langle 110 \rangle$ axes. For both single- and double-alignment measurements, the widths of the Bi distributions show significant narrowing relative to those for Si. Also, the Bi minimum yield is reduced from 16% for $\langle 110 \rangle$ single alignment to 5% for $\langle 110 \rangle$ uniaxial double alignment. Angular-distribution calculations based on the average-potential model were made for single-alignment axial channeling as a function of equilibrium displacement of an atom from a substitutional lattice site. The best agreement with the data is obtained for the case of $\approx 50\%$ of the Bi displaced 0.45 Å from Si lattice sites and the remaining Bi atoms located substitutionally on Si lattice sites. (auth)

44555 ENHANCED DIFFUSION IN Si AND Ge BY LIGHT ION IMPLANTATION. Minear, Roger L.; Nelson, Daniel G.; Gibbons, James F. (Stanford Univ., Calif). J. Appl. Phys.; 43: No. 8, 3468-9(Aug 1972).

Theoretical and experimental results are presented of investigations of impurity-atom diffusion enhancement in Si and Ge crystals under light-ion bombardment. Using existing ion range and displacement mechanism theories, a continuity equation for bombardment-generated defects is written and solved to give an expression for the steady-state excess defect concentration as a function of depth in the crystal. With the aid of existing diffusion theory, this is interpreted as a spatially varying atomic diffusivity which is a function of the bombarding beam parameters, temperature, the atomic species, and an experimentally measurable defect diffusion length. This spatially varying diffusivity, inserted in an appropriate diffusion equation, determines the evolution of the distribution of any impurity species diffusing by a defect-related mechanism. Some numerical solutions of this equation and some analytic solutions of interest are given, and a comparison of theory and experiment is presented. Among the results of this comparison are (i) defect diffusion length measurements of 0.27 μ in p-type Ge, and 0.086 μ in n-type Si, (ii) a measured yield of approximately 25 mobile defects/proton in either Ge or Si, mostly clustered at the end of the proton's track. A simple method is presented for the experimental measurement of the required defect diffusion length. Impurity concentration profiles of the proton-enhanced diffusion of ^{31}P in Ge and B in Si were measured, and experimental checks of several theoretical predictions were carried out. There are some indications of a diffusivity saturation at high beam currents in Si which may result from the generation of immobile defect clusters. Impurity diffusivity enhancement by a factor of greater than 10^5 was observed in Si. Several physical parameter values of interest are calculated. Transmission electron microscopy measurements were undertaken to observe the effects of the bombardment on crystal-line order in Si, and V–I and C–V characteristics of p–n diodes produced using enhanced diffusion of B in Si were examined. The uses of bombardment-enhanced diffusion as a device fabrication tool are discussed, and some unresolved topics are indicated. (auth)

44556 ELECTRON PARAMAGNETIC RESONANCE OF THE LATTICE DAMAGE IN OXYGEN-IMPLANTED SILICON. Brower, K. L.; Beezhold, Wendland (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 8, 3499-3506(Aug 1972).

The nature of the lattice damage produced at room temperature in ion-implanted intrinsic and n-type silicon was studied as a function of 160-keV O^+ ion fluence using electron paramagnetic resonance (EPR). The known EPR spectra observed were the negative divacancy (Si-G7), the neutral vacancy-oxygen (Si-S1), the neutral 4-vacancy (Si-P3), and the isotropic resonance at $g = 2.0055$ which is indicative of amorphous silicon. In addition, a new spectrum, labeled Si-S2, was observed which may be the negative 4-vacancy. Concentrations (number/cm^2) for the various paramagnetic defects were determined as a function of ion fluence for fluences ranging from 10^{10} to 10^{17} O^+ cm^2. From these measurements, it is concluded that the lattice damage produced in crystalline silicon by individual ions whose maximum calculated energy density into atomic processes is $\lesssim 15$ eV/Å ion consists of simple defects such as observed in electron- and neutron-irradiated silicon. Furthermore, overlap effects in the lattice damage produced by ion implantation are small providing the maximum energy density into atomic processes is $\lesssim 1.5 \times 10^{19}$ keV/cm^3. For energy densities into atomic processes between $\sim 1.5 \times 10^{19}$ and $\sim 10^{21}$ keV/cm^3, there appears to be an accumulation of defect complexes which are characterized by a high concentration of defects whose electrons tend to be delocalized among the defects within the complex. Finally, the measurements indicate that $\sim 10^{21}$ keV/cm^3 of energy into atomic processes must be accumulated in the form of lattice damage in order to convert crystalline silicon to the amorphous state. (auth)

Physical Properties

Refer also to abstracts 44164 and 45051.

44557 (COO–3427-7) THERMAL, STRUCTURAL, AND MAGNETIC STUDIES OF METALS AND INTERMETALLIC COMPOUNDS. Annual Report, May 15, 1971–May 15, 1972. Wallace, W. E.; Craig, R. S. (Pittsburgh Univ., Pa. Dept. of Chemistry). 1 Jun 1972. Contract AT(11-1)-3429. 40p. Dep. NTIS.

ALUMINUM ALLOYS—Al–Ho, thermal capacity of $HoAl_2$ at low temperatures
CALCIUM ALLOYS—Ca–Co–Gd, magnetic properties of $Gd_{1-x}Ca_xCo_5$
CERIUM—effects on magnetic properties of $GdFe_2$
CERIUM ALLOYS—Ce–Co, thermal capacity of $CeCo_2$ at 1.6 to 300°K
—Ce–Co–Ho, magnetic properties of $Ho_xCe_{1-x}Co_5$
—Ce–Co–Y, structure and magnetic properties of $Ce_{1-x}Y_xCo_5$
—Ce–Co–La, structure and magnetic properties of $Ce_{1-x}La_xCo_5$
COBALT ALLOYS—Ce–Co, thermal capacity of $CeCo_2$ at 1.6 to 300°K
—Ce–Co–Ho, magnetic properties of $Ho_xCe_{1-x}Co_5$
—Co–Ho–Th, magnetic properties of $Ho_xTh_{1-x}Co_5$
—Ca–Co–Gd, magnetic properties of $Gd_{1-x}Ca_xCo_5$
—Co–Yb, structure of intermetallics
—Ce–Co–Y, structure and magnetic properties of $Ce_{1-x}Y_xCo_5$
—Co–La–Y, structure and magnetic properties of $La_{1-x}Y_xCo_5$
—Co–Pr–Y, structure and magnetic properties of $Pr_{1-x}Y_xCo_5$
—Ce–Co–La, structure and magnetic properties of $Ce_{1-x}La_xCo_5$
—Co–La–Pr, structure and magnetic properties of $La_{1-x}Pr_xCo_5$
DYSPROSIUM ALLOYS—Dy–In, magnetic properties of Dy_3In
ERBIUM ALLOYS—Er–In, magnetic properties of Er_3In
GADOLINIUM ALLOYS—Ca–Co–Gd, magnetic properties of $Gd_{1-x}Ca_xCo_5$
—Gd–In, magnetic properties of Gd_3In
—Fe–Gd, magnetic properties of $GdFe_2$, effects of cerium and thorium additions on
HOLMIUM ALLOYS—Al–Ho, thermal capacity of $HoAl_2$ at low temperatures
—Ce–Co–Ho, magnetic properties of $Ho_xCe_{1-x}Co_5$
—Co–Ho–Th, magnetic properties of $Ho_xTh_{1-x}Co_5$
INDIUM ALLOYS—In–Pr, magnetic properties of Pr_3In
—In–Nd, magnetic properties of Nd_3In
—Gd–In, magnetic properties of Gd_3In
—Dy–In, magnetic properties of Dy_3In
—Er–In, magnetic properties of Er_3In
IRON ALLOYS—Fe–Yb, structure of intermetallics
—Fe–Gd, magnetic properties of $GdFe_2$, effects of cerium and thorium additions on
LANTHANUM ALLOYS—Co–La–Y, structure and magnetic properties of $La_{1-x}Y_xCo_5$
—Ce–Co–La, structure and magnetic properties of $Ce_{1-x}La_xCo_5$
—Co–La–Pr, structure and magnetic properties of $La_{1-x}Pr_xCo_5$

NEODYMIUM ALLOYS—In–Nd, magnetic properties of Nd_3In
NICKEL ALLOYS—Ni–Yb, structure of intermetallics
PRASEODYMIUM ALLOYS—In–Pr, magnetic properties of Pr_3In
—Co–Pr–Y, structure and magnetic properties of $Pr_{1-x}Y_xCo_5$
—Co–La–Pr, structure and magnetic properties of $La_{1-x}Pr_xCo_5$
THORIUM—effects on magnetic properties of $GdFe_2$
—Co–Ho–Th, magnetic properties of $Ho_xTh_{1-x}Co_5$
VACUUM TECHNIQUES—degassing effects on properties of rare-earth intermetallic compounds
YTTERBIUM—effects on RCo_5 intermetallic phases
YTTERBIUM ALLOYS—Fe–Yb, structure of intermetallics
—Co–Yb, structure of intermetallics
—Ni–Yb, structure of intermetallics
YTTRIUM ALLOYS—Ce–Co–Y, structure and magnetic properties of $Ce_{1-x}Y_xCo_5$
—Co–La–Y, structure and magnetic properties of $La_{1-x}Y_xCo_5$
—Co–Pr–Y, structure and magnetic properties of $Pr_{1-x}Y_xCo_5$
(D.L.C.)

44558 (IS-T-515) TIGHT-BINDING INTERPOLATION SCHEMES APPLIED TO MOLYBDENUM AND COPPER. Iverson, Randall Jay (Ames Lab., Iowa). May 1972. Contract W-7405-eng-82. 36p. Dep. NTIS.

Thesis.

Tight-binding interpolation schemes which represent transition- and noble-metal s, p, and d bands were applied to molybdenum and copper. A tight-binding scheme for bcc metals was used to fit first-principles calculations of the energy bands of Mo and obtain Fermi surfaces, which were compared to de Haas–van Alphen and radio frequency size-effect experimental data. A spin–orbit parameter of 0.0075 Ry (equal to the atomic spin–orbit parameter) was found to give the proper cross-sectional areas for the electron lens on the Δ axis and the neck of the electron jack; this value also gave a separation of 0.012 ($2\pi/a$) between the hole octahedron and the electron jack along the Δ axis, in agreement with the de Haas–van Alphen data, but in disagreement with the radio frequency size-effect data. A tight-binding interpolation scheme for fcc metals was developed, applied to Cu, and compared to the widely used LCAO–OPW interpolation scheme. It appears that the only significant differences appear above the top of the pure d bands, where the tight-binding scheme has too low a density of states and the LCAO–OPW scheme too high a density of states compared to the first-principles calculations. (auth)

44559 (RISO-252) MAGNETO-ELASTIC INTERACTIONS IN THE HEAVY RARE-EARTH METALS AND THE ELASTIC PROPERTIES OF TERBIUM. Jensen, Jens (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1971. 101p. Dep. NTIS (U. S. Sales Only).

With the Hamiltonian for linear magneto–elastic coupling proposed by Callen and Callen, expressions were deduced for changes in the velocity of acoustic waves in terbium and dysprosium due to ferromagnetic ordering and the application of an external magnetic field. These calculations are in fair agreement with experimental results. The extent to which this simple picture may be used to explain the magnon–phonon interactions in terbium was also examined. The magneto–elastic contributions to the spin-wave energies were considered in detail, and the "flexible lattice" calculations performed by Cooper were examined critically. Experimental measurements of the elastic constants of terbium as functions of temperature are presented. Strong coupling between the lattice and the spin system is observed. Recent experimental results for ferromagnetic terbium obtained by means of inelastic neutron scattering show that the two-ion exchange interaction in the c-direction is highly anisotropic. (auth)

44560 (RISO-258) PHYSICS DEPARTMENT ANNUAL PROGRESS REPORT, JANUARY 1–DECEMBER 31, 1971. Moeller, H. Bjerrum; Christensen, C. J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972. 58p. Dep. NTIS (U. S. Sales Only).

ANTIMONY ALLOYS—Ce–Sb, magnetic structure of CeSb, neutron-diffraction study of
BENZENE, p-DICHLORO-—lattice vibration dispersion curves for deuterated, from neutron scattering
CERIUM ALLOYS—Ce–Sb, magnetic structure of CeSb, neutron-diffraction study of
DEUTERIUM—phonon energies in ortho-, effects of pressure and temperature on
EUROPIUM—magnetic structure down to 4.2°K, neutron-diffraction study of
HOLMIUM—magnon dispersion relation in ferromagnetic, at 4.2°K
HYDROGEN—phonon dispersion relations and Debye–Waller factor for solid para-
MAGNETIC MIRROR MACHINES—research in
METEOROLOGY—research in
NEODYMIUM ALLOYS—Nd–Pr-base, magnetic structure of, neutron-diffraction study of
NEODYMIUM ARSENIDES—crystal-field transitions, neutron-scattering study
NEODYMIUM PHOSPHIDES—crystal-field transitions, neutron-scattering study
PLASMA—research on physics of
PRASEODYMIUM—magnetic structure of, neutron-diffraction study of
—magnetic excitons in
—Nd–Pr-base, magnetic structure of, neutron-diffraction study of
PROTONS—stopping powers in metals
RUBIDIUM NICKEL FLUORIDES—spin wave dispersion relation for ferrimagnetic $RbNiF_3$
TERBIUM—magnetic anisotropy of, single- and two-ion
(D.L.C.)

44561 DETERMINATION OF MONOVACANCY FORMATION ENERGIES FROM THE TEMPERATURE DEPENDENCE OF POSITRON ANNIHILATION IN METALS. Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart. Univ., Stuttgart). Phys. Lett.; 40A: No. 2, 135-6(3 Jul 1972).

The effect of the temperature dependence of the mobility of thermalized positrons on the determination of the formation energies of vacancies from the temperature variation of the positron lifetime or the angular correlation of positron annihilation is calculated. (auth)

44562 FIELD DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY OF SOME DILUTE ALLOYS OF V IN Au. Van Dam, J. E. (Rijksuniversiteit, Leiden); Beck, P. A. Phys. Lett.; 40A: No. 2, 183-4(3 Jul 1972).

Magnetization data at low temperatures for quenched Au–V alloys (1 and 2 at. % V) are presented. From an analysis of these results, conclusions are drawn about the concentration dependence of the solute susceptibility. (auth)

44563 COMPUTATION OF THE MAGNETIZATION CURVE FOR VANADIUM AT T = 0°K. Leplae, L.; Mancini, F.; Umezawa, H. (Univ. of Wisconsin, Milwaukee). Phys. Lett. 40: A; No. 2, 177-8(3 Jul 1972).

The magnetization of pure vanadium for H close to H_{c1} at T = 0°K is calculated by the boson method. The results are in very good agreement with experiment. (auth)

44564 MAGNETIC FIELD AT TUNGSTEN NUCLEI IN IRON. Cameron, J. A.; Keszthelyi, L.; Mezei, G.; Szoekefalvi-Nagy, Z.; Varga, L. (Central Research Inst. for Physics, Budapest). Can. J. Phys.; 50: No. 8, 736-9(15 Apr 1972).

Larmor precession of the first 2+ states of ^{182}W and ^{184}W was observed in an iron alloy containing 5 at. % W. The levels were Coulomb excited with 2.5-MeV protons. The hyperfine energy in ^{182}W is the same as that found by Moessbauer absorption. The variation of the field up to 300°K is less than 6%. A comparison of g factors measured by the hyperfine field and the external field suggests the existence of a hyperfine anomaly. (auth)

44565 POSITRON ANNIHILATION IN METALS. Bhattacharyya, P.; Singwi, K. S. (Northwestern Univ., Evanston, Ill.). Phys. Rev. Lett.; 29: No. 1, 22-5(3 Jul 1972).

A nonlinear integral equation with three-body correlations is derived for the Fourier transform of the polarization charge around a positron in an electron liquid. The calculated annihilation rate of the positron in the entire metallic density range, besides being in very good agreement with experiment, merges smoothly into the mean positronium lifetime for larger density. To illustrate the large nonlinear effects, the polarization charge around a fixed proton for a density $r_s = 2$ was also calculated. (auth)

44566 X-RAY-DIFFRACTION STUDY OF DISLOCATIONS IN V_2O_5. Zaleska, M. (Inst. of Physics, Warsaw). Acta Phys. Pol.; A41: No. 6, 771-3(Jun 1972).

The density of dislocations in V_2O_5 single crystals was determined by the oscillating-film method. The goal of this study was, among other things, to compare dislocation densities obtained by x-ray analysis with those estimated from electron-microscopic recordings. Measurements led to the following result: in the examined crystals, the densities of screw dislocations were higher than those of edge dislocations, being 1.2×10^7 cm^{-2} as compared with 4.5×10^6 cm^{-2}. (auth)

44567 ANOMALOUS FIM IMAGES OF TUNGSTEN. Hren, J. J.; Moore, A. J. W.; Spink, J. A. (Univ. of Melbourne). Surface Sci.; 29: No. 2, 331-41(Feb 1972).

Unusual field-ion images consisting of bright bands of variable width parallel to the ⟨111⟩ zones were observed in tungsten at 78°K. Typical conditions for the effect are: pulse width 1 to 50 μsec and pulse height adjusted such that 5 to 10 pulses are required to remove one (110) plane. The influence of a number of accessible variables was studied and the results lead to a two-mechanism model for field evaporation involving: (1) a slow process requiring helium promotion and (2) unpromoted evaporation when the local helium supply is depleted at high rates. The model implies that helium diffusion is rate-limiting in the promotion mechanism and leads to a value of $E_m \simeq 0.15$ eV during field evaporation. There is a measurable difference in end form in the limits of high- and low-field evaporation rates. High rates are nearly isotropic and yield a more hemispherical end form. (auth)

44568 OBSERVATIONS OF ELECTRON REFLECTION AT TUNGSTEN (001) SURFACE IN THE ENERGY RANGE 1 TO 10 eV. McRae, E. G.; Wheatley, G. H. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Surface Sci.; 29: No. 2, 342-54(Feb 1972).

Measurements of electron reflection at tungsten (001) surface are reported. The measurements were made with a display-type LEED apparatus operated in the retarding mode. Results are given for clean tungsten and for surfaces formed by adsorption of gases on tungsten. The variation of diffraction intensity (arbitrary units) as a function of electron energy in the range 1 to 10 eV is described for the 00 and 01 beams. Measurements on clean tungsten are reported for a sequence of values of the angle of incidence ψ_0, for each of two azimuthal orientations of the primary beam (0 and 45° referred to the 01 direction in the crystal surface). The measurements on the 00 beam fill in the gap between those of Khan, Hobson and Armstrong and of Zollweg for normal incidence ($\psi_0 = 0$) and those of Propst and Edwards ($\psi_0 = 53°$) and are correlated with these earlier measurements. The chief observations are: (a) a narrow peak near 4 eV that is insensitive to both variation of primary-beam orientation and gas adsorption; and (b) a very narrow dip—peak combination whose location can be correlated with the 01 beam threshold (grazing-emergence) energy and whose location and shape are highly sensitive to gas adsorption. The observations support suggestions that (a) is connected with an inelastic-scattering threshold and that (b) is a surface-state resonance. (auth)

44569 FIELD EMISSION OF TUNGSTEN AFTER ADSORPTION OF HYDROCARBONS. Hellwig, S.; Block, J. H. (Max-Planck-Gesellschaft, Berlin). Surface Sci.; 29: No. 2, 523-39 (Feb 1972). (In German).

Field emission currents of electrons were measured for different planes of tungsten after the interaction of CH_4, C_2H_6, C_3H_8, and C_2H_4 at 78 and 298°K and used to obtain work function and pre-exponential values from Fowler—Nordheim plots. A critical analysis of these data yields a conclusive result on surface potentials only if emitting areas and pre-exponentials are comparable. As demonstrated by the field emission patterns, different surface planes of W chemisorb hydrocarbons in a selective manner. Methane at 298°K increases the average work function $\bar{\Phi}$ as well as $\Phi_{(011)}$ without appreciable change of the pre-exponential. A negative surface potential is formed by chemisorption. Methane at 78°K forms multilayers which facilitate resonance tunneling. With ethane and less pronounced with propane, remarkable changes of the pre-exponential are observed due to surface corrosion and/or whisker formation. Ethylene preferentially decreases the emission in areas between the (011), (112), and (001) surfaces, with an increase of the work function in all cases. The differences in the behavior of the hydrocarbons studied are related to different chemisorption states. (auth)

44570 NOTE ON ENERGY LOSS MEASUREMENTS IN TUNGSTEN. Burkstrand, J. M.; Propst, F. M.; Cooper, T. L.; Edwards, D. E. (Univ. of Illinois, Urbana). Surface Sci.; 29: No. 2, 663-6(Feb 1972).

The nature of the low-energy inelastic electron losses in W was studied using three different W(100) crystals. Energy losses at 1.5, 4.5-5.0, 10-12, 15-16, and 22-25 eV were observed, and their assignments to surface and bulk plasmons are discussed. (D.L.C.)

44571 ANALYSIS OF ANGULAR AND WAVE DEPENDENCE OF THE WIDTH OF X RAY DIFFRACTION LINES OF DEFORMED METALS. Vorob'ev, G. M.; Turba, N. N.; Gaivoronskaya, T. Z. (Dnepropetrovsk Metallurgical Inst., USSR). Metallofizika; No. 38, 45-51(1971). (In Russian).

The angular and wave dependence of the width of x-ray diffraction lines from deformed Mo and Nb were determined, using K_α radiation of Cr, Fe, and Mo. The calculations used the approximation method of the profile of diffraction lines by theoretical functions. The physical width of the diffraction lines of the deformed metals Mo and Nb was almost identical at different angles and with different radiation, which was explained by the small contribution to the total widening of the lines due to the dispersed blocks. Recommendations are given for the choice of conditions in measuring the magnitude of the blocks. (tr-auth)

44572 USE OF SYNCHROTRON RADIATION TO STUDY REFLECTION SPECTRA OF SOLIDS IN THE VACUUM-ULTRAVIOLET REGION. Korolev, F. A.; Kulikov, O. F. Opt. Spectrosc. (USSR) (Engl. Transl.); 31: No. 5, 442-3(Nov 1971).

Translated from Opt. Spektrosk.; 31: No. 5, 822-4(Nov 1971).

Synchrotron radiation from electrons accelerated in a synchrotron at 680 MeV was used to study the reflection spectra of various solids between 500 and 2700 Å. Reflection spectra of KCl and silicon crystals in this region are given at angles of 45 and 70°. (auth)

44573 MAGNETIC STUDY ON HEXAGONAL NITRIDES OF 3d TRANSITION METALS. Mekata, Mamoru; Yoshimura, Hiroshi; Takaki, Hideo (Kyoto Univ.). J. Phys. Soc. Jap.; 33: No. 1, 62-9(Jul 1972).

Magnetic and Moessbauer effect measurements on the nitrides with hcp metal lattice (V, Cr, Mn, and Fe) are carried out as a function of composition. Hexagonal VN_x and hexagonal CrN_x are Pauli-paramagnetic. Hexagonal MnN_x shows antiferromagnetism, while both hexagonal and orthorhombic FeN_x show ferromagnetism at low temperatures. In these phases, nitrogen atoms suppress magnetic ordering in consequence of the reduction of magnetic moments. As a whole, the observed types of magnetism of hexagonal nitrides resemble those of the mother metals in spite of the difference in crystal structures. Type-II superconductivity is found in hexagonal VN_x, although it is not yet conclusive. (auth)

44574 HYPERFINE FIELD AT Rh NUCLEI IN Fe—Rh ALLOYS. Keszthelyi, L.; Demeter, I.; Szoekefalvi-Nagy, Z.; Varga, L.; Mezei, G. (Central Research Inst. for Physics, Budapest). Phys. Status Solidi (b); 52: No. 1, 149-54(1 Jul 1972).

The concentration dependence of the hyperfine field at Rh nuclei in Fe—Rh alloys measured after Coulomb excitation by 2.5-MeV protons deviates from the concentration dependence measured by NMR method. In the case of $Fe_{51.5}Rh_{48.5}$ alloy, the field was observed to decrease exponentially with the irradiation dose. Both effects may be understood in terms of radiation damage theory. (auth)

44575 ORDERED MOMENT OF METALLIC SAMARIUM MATERIALS. Stewart, A. M. (Univ., Genoa). Phys. Status Solidi (b); 52: No. 1, K1-4(1 Jul 1972).

An estimate is made of the size of the ordered magnetic moment of a metallic Sm material. The case of a Sm ferromagnet at zero temperature is considered. Equations are derived for the orbital and spin angular momentum operators of the 4f shell. The relative importance of the various terms in the equation for the total magnetic moment per magnetic atom is estimated for a hypothetical Sm ferromagnet with a Curie temperature of 100°K, a $J(0)\rho$ of +0.1, and no crystal-field splitting. (D.L.C.)

44576 COMPARISON OF BACKSCATTERING INTENSITIES FOR LOW-ENERGY ELECTRONS FROM VARIOUS SURFACE ATOMS (H, Li, Be, C, O, Al, Si, S, V, Cr, Ni, Cu, Ag, Pt, Au). Fink, M. (Univ. of Texas, Austin); Martin, M. R.; Somorjai, G. A. Surface Sci.; 29: No. 1, 303-8(Jan 1972).

Atomic scattering factor calculations are made as a guide for LEED experiments. Two backscattering angles were used, 180 and 158°, and the electron energy interval was 50 to 200 eV. The graphs show that the electron backscattering intensity from H is about two orders of magnitude less than that from substrate metals, and that C and O have scattering intensities of the same order of magnitude as many metals near 50 eV, but they decrease monotonically with energy while these of metals do not show such a simple energy dependence. (D.L.C.)

44577 PRODUCTION OF POROUS TANTALUM ANODES OF ELECTROLYTIC CONDENSERS. Amosov, V. M.; Karelin, B. A.; Kisilenko, N. I.; Lutskii, V. K. (Moscow Electric Vacuum Instrument Factory). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 42-6(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 53-9(Jan 1972).

A study was made on the influence exerted by the amount of pore-forming agents (salts of alkali and alkaline earth metals), in the range 2 to 12 wt %, on the electrical parameters (capacitance and the tangent of the loss angle) of porous sintered tantalum anodes. It was found that adding a pore-forming agent to fine tantalum powder can approximately double the specific capacitance of porous anodes and, at the same time, substantially lower the tangent of their loss angle. (auth)

44578 L-SHELL SOFT-X-RAY APPEARANCE-POTENTIAL SPECTRA OF THE 3d TRANSITION METALS. Park, Robert L.; Houston, J. E. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., B; 6: No. 4, 1073-81(15 Aug 1972).

L-shape appearance-potential spectra are obtained for clean surfaces of the 3d transition metals: Sc, Ti, V, Cr, Mn, Fe, Co, and Ni. Spin–orbit splittings determined from these spectra are in excellent agreement with tabulated x-ray values. In all cases, however, the absolute binding energies are lower than the tabulated values, presumably as a result of the reduced coordination for surface atoms. The L_3/L_2 intensity ratios show a systematic variation with Z, approaching the expected statistical weighting of 2 only for a nearly empty (Sc) or nearly filled (Co and Ni) 3d band. It is less than 2 for all intermediate Z's with a minimum value of approximately 1 at Cr. The L_3, L_2 peak widths decrease with Z corresponding to the filling of the 3d band. The L_1 width, which is determined primarily by Auger lifetime broadening rather than the density of conduction-band states, exhibits a systematic decrease for Z > 24 in contrast to theoretical predictions. (auth)

44579 ORIENTATIONAL ORDER PARAMETER IN CUBIC D_2. Meyer, H. (Duke Univ., Durham, N. C.); Weinhaus, F.; Maraviglia, B.; Mills, R. L. Phys. Rev., B; 6: No. 4, 1112-21(15 Aug 1972).

A study was made of the orientational order parameter σ for D_2 molecules with both rotational angular momentum J = 1 (para-D_2) and J = 0 (ortho-D_2) in the ordered cubic phase. The study covers the temperature range between 0.4 and 4°K at mole fractions X of (J = 1) molecules $0.55 \leq X \leq 0.96$. The order parameters $\sigma_{(J=1)}$ (T, X) and $\sigma_{(J=0)}$ (T, X) are proportional to the respective doublet splitting observed in the NMR spectrum. In the ordered phase, two doublets spaced symmetrically around the central Larmor frequency are recorded. The outer one, with a splitting $\sigma\nu_{(J=1)}$ up to about 78 kHz, represents the signal from the (J = 1) molecules. The inner one, with splitting $\delta\nu_{(J=0)}$ an order of magnitude smaller than $\delta\nu_{(J=1)}$, is caused by polarization of the (J = 0) molecules by the (J = 1) field. A description is presented of the line shape as a function of T and X. Using the results from several samples, the extrapolated (J = 1) order parameter was obtained for X = 1 as a function of T. At the order–disorder transition temperature T_λ, the doublet structure suddenly disappears and is replaced by a sharp central line which is characteristic of the orientationally disordered phase. The first-order nature of the transition is thus clearly shown. The experimental order parameter for (J = 1) molecules $\sigma_{(J=1)}$ (X = 1, T) is compared with predictions from a mean-field and a cluster-variation theory, and also with results from Raman spectroscopy. As X decreases, the line structure shows a progressively greater temperature variation and becomes more smeared out as the order–disordered transition is approached. Below a critical mole fraction $X_c = 0.54$, obtained by extrapolation, no doublet structure is observed. The limiting value of both $\sigma_{(J=1)}$ and $\sigma_{(J=0)}$ as a function of X at $T \ll T_\lambda(X)$ is in good agreement with predictions by Harris. A fit of the experiment to theory leads to a factor of about 0.02 for the reduction of the order parameter by the zero-point motion, in agreement with theoretical predictions. It is also shown that, within experimental error, the temperature variation of both order parameters $\sigma_{(J=1)}$ and $\sigma_{(J=0)}$ for a given X is the same. The failure to observe the doublet splitting for the NMR pair spectrum of two neighboring (J = 1) molecules in an hcp D_2 sample with X = 0.05 is briefly discussed, and other peculiarities that at this time remain unexplained for dilute mixtures of (J = 1) molecules in (J = 0) D_2 are mentioned. The possible existence of a large crystalline field that might account for these anomalies is suggested. (auth)

44580 STUDY OF V_2O_3 BY X-RAY PHOTOELECTRON SPECTROSCOPY. Honig, J. M. (Purdue Univ., Lafayette, Ind.); Van Zandt, L. L.; Board, R. D.; Weaver, H. E. Phys. Rev., B; 6: No. 4, 1323-8(15 Aug 1972).

The band structure of V_2O_3 below the Fermi level was studied by x-ray photoelectron spectroscopy both above and below the Néel temperature. Aside from normal bands associated with atomic states from 20 to 640 eV, a valence band with structure was observed in the range 0 to 10 eV. The results are compared to soft-x-ray-emission and -absorption results and to theoretical predictions concerning the band structure of V_2O_3. (auth)

44581 OPTICALLY INDUCED PARAMETRIC INSTABILITIES IN SEMICONDUCTING PLASMAS. Gersten, J. I.; Tzoar, N. (City Coll., New York). Phys. Rev., B; 6: No. 4, 1375-82 (15 Aug 1972).

The parametric generation of plasma waves from coherent electromagnetic radiation in semiconductors is considered. Three mechanisms which lead to a parametric instability are discussed. In the first mechanism the incident-radiation frequency matches the plasmon frequency. In the second case the plasma is allowed to drift, and radiation at twice the plasma frequency induces an instability. In the third instance two beams at frequencies ω_1 and $\omega_1-\omega_p$ create a parametric instability. Application of the theory to InSb indicates that it should be possible to excite all three types of instabilities with currently available technology. (auth)

44582 ELASTIC CONSTANTS OF TERBIUM BETWEEN 78 AND 300K. Salama, K.; Brotzen, F. R.; Donoho, P. L. (Rice Univ., Houston, Tex.). J. Appl. Phys.; 43: No. 8, 3254-8(Aug 1972).

The adiabatic elastic constants of terbium were determined in the temperature range 78 to 300°K, using high-purity single crystals. The constants were obtained from the ultrasonic wave velocities (20 MHz) measured by the pulse-superposition method. The values of the constants c_{33}, c_{44}, c_{12}, and c_{13} at room temperature in units of 10^{11} dyn/cm^2 are 7.225, 2.140, 6.788, 2.432, and 2.299, respectively. Using these values, the Debye temperature was computed to be 176.6°K. The velocities tend to vary with temperature in an anomalous fashion near the magnetic phase transitions, i.e., the Néel and Curie temperatures, 229 and 221°K, respectively. The relative change of the longitudinal velocity in the [0001] direction, near the Néel temperature, T_N, could be described by a logarithmic function of the reduced temperature $(T-T_N)/T_N$. The rate of the relaxation process of this relationship was estimated to be 6×10^9 sec^{-1}. (auth)

44583 PILEUPS OF ELLIPTICAL DISLOCATION LOOPS IN A HEXAGONAL CRYSTAL. Chou, Y. T. (Lehigh Univ., Bethlehem, Pa.). J. Appl. Phys.; 43: No. 8, 3271-4(Aug 1972).

Pileups of elliptical dislocation loops on the basal plane of a hexagonal crystal are analyzed. Explicit expressions for the distribution function, the number of loops, and the elastic energy of a pileup are derived. The average stress concentration along the tip of the pileup (the average tip stress) is calculated by using Moutier's theorem. Results are given for ten materials: Be, Ti, Cd, graphite, Mg, Co, Hf, H_2O, Zn, and Zr. (auth)

44584 ELASTIC CONSTANTS OF NIOBIUM–MOLYBDENUM ALLOYS IN THE TEMPERATURE RANGE -190 TO +100°C. Hubbell, W. C.; Brotzen, F. R. (Rice Univ., Houston, Tex.). J. Appl. Phys.; 43: No. 8, 3306-12(Aug 1972).

Adiabatic elastic constants were determined for niobium and niobium–molybdenum alloys of the following nominal compositions 15, 25, 35, 50, 75, and 90 wt.% Mo. The c_{11}, c_{12}, and c_{44} elastic constants of these bcc alloys were tabulated between −190 and +100°C. The effects of compositional changes on the elastic constants were far greater than those due to temperature. An anomalous temperature dependence for c_{44} was found for the niobium-rich alloys. An analysis of the elastic constants in terms of central forces revealed that nearest- and second-nearest-neighbor force constants rise with molybdenum additions, with the latter tending towards a maximum as the composition of pure molybdenum is approached. This is thought to be associated with the filling of a d subband. Debye temperatures were computed and found to be generally in good agreement with the calorimetrically determined values reported in the literature. (auth)

44585 ELECTRONIC BAND STRUCTURE AND OPTICAL PROPERTIES OF 3C-SiC, BP, AND BN. Hemstreet, L. A. Jr.; Fong, C. Y. (Univ. of California, Davis). Phys. Rev., B; 6: No. 4, 1464-80(15 Aug 1972).

The energy band structure and optical properties of the zinc-blende semiconductors 3C–SiC, BP, and BN were calculated using a nonlocal version of the empirical-pseudopotential method. The results of this investigation are discussed and compared to experiment. The agreement between theory and experiment is found to be very good for both SiC and PB. The BN results are quite rough, owing to some very questionable assumptions made necessary because of the scarcity of experimental data. However, the results seem to give a reasonable first approximation to the correct band structure. The effect of the nonlocal p pseudopotential on these three crystals is discussed. (auth)

44586 AC CONDUCTIVITY OF SCANDIUM OXIDE AND A NEW HOPPING MODEL FOR CONDUCTIVITY. Pike, G. E. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., B; 6: No. 4, 1572-80(15 Aug 1972).

The ac conductivity of scandium-oxide thin films in the audio-frequency range at temperatures between 4 and 295°K was measured. The frequency-dependent component of the conductivity was found to obey an equation of the form $\sigma_1(\omega) = A\omega^s$, where ω is the circular frequency and s is a temperature-dependent quantity whose value is close to, but less than, unity. Interpretation of the results in terms of a single-phonon hopping theory does not yield satisfactory agreement. To account for the data, a new hopping model is proposed. The conductivity is calculated for classical hopping of carriers between localization sites over potential barriers with a height distribution caused by the random spatial distribution of these sites. This model yields the ω^s behavior at high frequencies with the quantity $(1 - s)$ increasing almost linearly with temperature. In addition, it is predicted that a thermally activated dielectric-loss peak should occur for very low frequencies. It is suggested that this model may find broad application in the interpretation of ac conductivity results in amorphous materials. (auth)

44587 OPTICAL PROPERTIES OF THIN-FILM MOLYBDENUM. Gravier, Pierre (Univ. de Provence, Marseille). Thin Solid Films; 11: No. 1, 135-51(Jul 1972). (In French).

The discontinuous structure of thin metallic films usually results in their optical properties being different from those of the bulk metal. High-melting-point metals, however, give only slightly granulated films, with the possibility that their optical properties may be somewhat closer to that of the metal. It is shown that with molybdenum thin films the complex index found is near that for the bulk metal and that the optically equivalent thickness is equal to the bulk thickness. (auth)

44588 SOME PROPERTIES AND ELECTRICAL INSTABILITIES IN RF SPUTTERED NIOBIUM OXIDE FILMS. Chen, Mao-chieh (General Motors Corp., Warren, Mich.). J. Electrochem. Soc.; 119: No. 7, 887-92(Jul 1972).

Niobium oxide films were prepared by rf sputtering in an oxygen atmosphere and various electrical properties were investigated. Forms of ionic instability in the oxide layer were studied in relation to changes in the flat-band voltage during MOS capacitance measurements. As sputtered, the films exhibited the presence of both highly mobile positive and negative ionic charges. When annealed at 800°C in a helium or an oxygen atmosphere, the films exhibited only positive ionic charge. Inclusion of a small amount of trichloroethylene in the oxygen annealing process resulted in oxide films essentially free from ionic instability. (auth)

44589 THERMODYNAMIC PROPERTIES OF TERNARY REFRACTORY CARBIDES. III. RELATIONS BETWEEN THERMODYNAMIC PROPERTIES, BONDING, AND COMPRESSIBILITY. Hoch, M.; Yamauchi, S. (Univ. of Cincinnati). J. Electrochem. Soc.; 119: No. 7, 970-3(Jul 1972).

The high-temperature thermodynamic data previously obtained on ternary carbides having the sodium chloride structure are correlated with the bonding and mechanical properties of these carbides. The metal—metal bonding on the metal sublattice in the carbide is found to be the same as in the binary body-centered-cubic metals. The variation of the carbon—carbon and metal—carbon interaction energies is interpreted to mean that the metal—carbon bonds are localized bonds. From the dependence of metal—carbon interaction energy on composition at elevated temperatures the compressibility of the carbides was calculated. The values obtained agree to within a factor of two with values derived from room temperature measurements of mechanical properties. The results show that the metal—carbon bond is responsible for the carbide properties and that the metal—metal and carbon—carbon bonds play a minor role. (auth)

44590 INSTABILITY OF A DRIFTING SEMICONDUCTOR PLASMA IN A TRANSVERSE MAGNETIC FIELD. Burke, B. E.; Kino, G. S. (Stanford Univ., Calif.). J. Appl. Phys.; 43: No. 8, 3335-45(Aug 1972).

A new theory to determine the rate of spatial growth of carrier waves propagating in an electron-hole plasma in InSb is derived. The theory is an extension of previous work on surface carrier waves which takes account of diffusion. The results indicate that the threshold velocity for gain is proportional to the square root of the frequency, and the magnetic field for maximum gain is such that $\mu_e B > 1$. Experimental measurements of growing waves were carried out using InSb with frequencies in the range 10 to 180 MHz. Noise measurements which indicated the presence of oscillations due to this same amplification mechanism were carried out at frequencies up to 800 MHz. The observed rates of growth are lower, and the measured threshold velocity is higher than the theory indicates. This is because the Suhl effect is neglected in the theory. (auth)

44591 CHANNELING MEASURMENTS IN As-DOPED Si. Haskell, J.; Rimini, E.; Mayer, J. W. (California Inst. of Tech., Pasadena). J. Appl. Phys.; 43: No. 8, 3425-31(Aug 1972).

Channeling-effect measurements with 1.8-MeV helium ions on silicon samples doped with arsenic to concentrations up to 1.5×10^{21} atoms/cm^3 indicate that greater than 90% of the arsenic atoms occupy substitutional lattice sites. A narrowing of the angular-yield profile is observed for arsenic concentrations in excess of 10^{20} atoms/cm^3. A movement of arsenic atoms off substitutional lattice sites is observed after bombardment with MeV helium ions. The initial rate of movement (10^{17} As atoms/cm/μC) is independent of the arsenic concentration. In arsenic-diffused samples subjected to prolonged heat treatment at temperatures between 650 and 900°C, an increase is seen in both silicon and arsenic aligned yields. The relative increase in the arsenic aligned yield is less than the relative increase in sheet resistance. (auth)

44592 NOISE CONSIDERATIONS FOR INFRARED QUANTUM COUNTERS: THE OXYGEN-FIRED CdF_2:Er^{3+} IRQC. Byer, N. E. (Martin Marietta Corp., Baltimore). J. Appl. Phys.; 43: No. 8, 3567-70(Aug 1972).

The contributions to the noise equivalent power (NEP) from various noise sources were analyzed for the oxygen-fired CdF_2:Er^{3+} infrared quantum counter (IRQC) proposed recently as a detector for 1.5-μm radiation. The noise from photomultiplier dark current and from thermal, Raman, or two-photon excitations are estimated to produce comparable contributions to the NEP, approximately 10^{-13} W Hz$^{-1/2}$, which is superior to that of conventional uncooled 1.5-μm detectors. The IRQC is expected to be background noise-limited at 385°K. Methods to improve the performance of the IRQC are discussed. (auth)

44593 ANISOTROPIC HOT-ELECTRON MICROWAVE CONDUCTIVITY OF n-InSb AT 84 K AND 134 GHz. Loeschner, H. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys.; 43: No. 8, 3585-6(Aug 1972).

High-precision measurements of the anisotropic complex small-signal microwave conductivity of hot electrons in n-InSb at 84°K and 134 GHz were performed. An unexpected "plateau" in the experimental curve of the real part of the ac conductivity parallel to the dc electric field vs. the field strength is found between 50 and 100 V/cm. (auth)

44594 SURFACE ENERGY FOR BRITTLE FRACTURE IN METALS FROM PHONON FREQUENCIES. Caglioti, G. (Politecnico, Milan); Rizzi, G.; Bilello, J. C. J. Appl. Phys.; 43: No. 8, 3600-1(Aug 1972).

The calculations of Caglioti, Rizzi, and Bilello are extended to include second and third neighbors for Fe, Na, W, Cu, and Al. (auth)

Moessbauer Effects and NMR

Refer also to abstracts 43074, 43075, and 43165.

44595 ELECTRIC QUADRUPOLE INTERACTION OF ^{181}Ta IN HEXAGONAL TRANSITION METALS. Kaindl, G.; Salomon, D. (Univ. of California, Berkeley). Phys. Lett.; 40A: No. 2, 179-80 (3 Jul 1972).

The electric quadrupole interaction of ^{181}Ta impurity atoms in the hexagonal transition metals Re, Os, Hf and Ru was studied at room temperature. From the resolved Moessbauer absorption spectra, values for the electric field gradients at the ^{181}Ta nucleus and for the isomer shifts of the 6.2 keV gamma rays were obtained. (auth)

44596 NUCLEAR QUADRUPOLE DIFFRACTION OF RESONANT GAMMA RADIATION IN A TELLURIUM SINGLE CRYSTAL. Zasimov, V. S.; Kuz'min, R. N.; Aleksandrov, A. Yu.; Firov, A. I. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 15: No. 7, 277-80(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 394-8(5 Apr 1972).

The results are reported of diffraction experiments on the scattering of the resonant gamma radiation from ^{125m}Te by a tellurium single crystal. The diffraction spectra are given for reflections from the (0003) and (0001) planes. (M.O.W.)

44597 ULTRASONIC SATURATION OF NUCLEAR-RESONANCE SIGNALS IN CRYSTALS. Antokol'skii, G. L.; Fershman, L. N.; Shutilov, V. A. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 11, 2932-3(May 1972).

Translated from Fiz. Tverd. Tela; 13: No. 11, 3467-9(Nov 1971).

The case of quadrupole acoustic saturation of equidistant nuclear Zeeman energy levels is considered. The Hamiltonian function of the system is derived, and the change in the steady-state temperature of the nuclear spin system under acoustic saturation conditions is calculated. An equation is derived for the ratio of inverse temperatures or acoustic saturation factor as a function of the ultrasonic frequency ω. For $\omega = \omega_0$ (Larmor precession frequency), the presence of a dipole—dipole reservoir does not affect the acoustic saturation of the center of the NMR line. The magnitude of the dipole–dipole reservoir correction for a frequency detuning Δω is discussed. (D.L.C.)

Theory

44598 DESCRIPTION OF A MANY-ELECTRON SYSTEM. Miranda, L. C. M.; ter Haar, D. (Oxford Univ.). Phys. Norv.; 5: No. 3-4, 225-7(1971).

How far the description of a system of electrons embedded in a positively charged uniform background through a Hamiltonian including plasmon terms is consistent is discussed. (auth)

44599 QUANTUM CRYSTALS IN THE SINGLE-PARTICLE PICTURE. Caron, Laurent G. (California Inst. of Tech., Pasadena). Phys. Rev., B; 6: No. 4, 1081-90(15 Aug 1972).

A low-temperature formalism for quantum crystals based on the localized-single-particle picture is presented. A proposed transcription to a quasi-particle space provides the basis for an easily accessible thermal analysis. It also yields correlation and lifetime information. The excitations are shown to be the same as Werthamer's. The effect of wave-function overlap and its impact on magnetism are also discussed. Lastly, the defect crystal is examined. (auth)

PHYSICS (THEORETICAL)

Refer also to abstracts 43924 and 44110.

44600 STABILITY OF SYSTEMS WITH SINGULAR POTENTIALS. Simenog, I. V. (Inst. for Theoretical Physics, Kiev). Phys. Lett.; 40B: No. 1, 53-4(12 Jun 1972).

It is shown, for systems with singular attractive potentials, that the concept of independent particles in the Hartree sense is exactly realized in the asymptotic limit $N \rightarrow \infty$. (auth)

44601 QUANTUM MECHANICS OF A NONLINEAR SYSTEM. Omote, Minoru; Sato, Haruo (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1367-77(Apr 1972).

A procedure is given for constructing a Hamiltonian quantum theory for a system with a nonlinear (classical) Lagrangian. It is shown that the resulting formalism retains all the symmetry properties possessed by the original Lagrangian. (auth)

44602 FORTRAN SUBROUTINE FOR CALCULATING THE BESSEL FUNCTIONS $j_l(\rho)$, $J_{l+\frac{1}{2}}(\rho)$ AND THEIR DERIVATIVES. Carstoiu, B. (Inst. of Atomic Physics, Bucharest); Deberth, C.; Sandulescu, A. Rev. Roum. Phys.; 17: No. 3, 409-11(1972).

A subroutine for the calculation of the Bessel functions $j_l(\rho)$, $J_{l+\frac{1}{2}}(\rho)$ and their derivatives based on the relations between these functions and the regular Coulomb function $F_l(\eta,\rho)$ with $\eta = 0$ is given. The subroutine is written in FORTRAN IV for the IBM 360. (1 table) (R.W.R.)

44603 SPURIOUS STATES PROBLEM AND AN EXTENSION OF THE RPA. da Providencia, J. (Univ., Coimbra); Shakin, C. M. Port. Phys.; 5: No. 1-2, 31-47(1967-1968).

Corrections to RPA transition amplitudes arising from ground state correlations due to the zero point motion of the several degrees of freedom have been considered elsewhere. Since a complete set of states was required in the derivations the zero point motion of the spurious degrees of freedom was also involved in the expressions obtained for transition amplitudes. It is shown that the contribution of the spurious states actually cancels out in those expressions if the transition operator commutes with collective operators such as center of mass position and total momentum. (auth)

REACTOR TECHNOLOGY

Power Reactor Developme

Refer also to abstracts 42914 and 45051.

44604 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1972 ANNUAL MEETING, LAS VEGAS, NEVADA, JUNE 18–22, 1972. Farmakes, Ruth (ed.). Trans. Amer. Nucl. Soc.; 15: No. 1, 1-583(Jun 1972). (CONF-720607).

Included are 614 brief summaries of papers on various aspects of nuclear science and technology. The summaries were presented in technical sessions entitled: Aerospace; Civil Explosion Applications; Controlled Nuclear Fusion; Education; Environmental Sciences; Fuel Cycle; Isotopes and Radiation; Materials Science and Technology; Mathematics and Computation; Nuclear Criticality Safety; Nuclear Reactor Safety; Power; Reactor Operations; Reactor Physics; and Shielding and Dosimetry. Each summary is listed separately in NSA. (D.C.C.)

For abstracts of individual papers see: 42695–42704, 42725, 42781, 42782, 42828, 42843–42845, 42849–42860, 42873–42890, 42900, 42901, 42910–42914, 42921, 42922, 42925–42930, 42932–42936, 42942, 42943, 42948, 42949, 42954, 42959, 42963–42966, 42969–42978, 42985–42988, 43010–43022, 43069, 43070, 43076–43080, 43104, 43114, 43155, 43166–43169, 43201–43207, 43212–43216, 43222–43224, 43242, 43288–43293, 43321, 43322, 43370, 43377, 43424–43440, 43477–43480, 43496–43498, 43541–43545, 43593–43610, 43614–43617, 43627–43632, 43635–43637, 43640–43644, 43652, 43653, 43656–43659, 43684–43686, 43695–43705, 43793, 43885, 43948, 44186–44208, 44227, 44247, 44261, 44262, 44297, 44302–44319, 44330–44334, 44424–44434, 44477–44491, 44508–44515, 44606–44637, 44645–44654, 44656–44754, 44756, 44765, 44768, 44769, 44772–44778, 44783–44787, 44824–44829, 44924–44936, 44938–44995, 44997–45007, 45009–45048, and 45169–45180.

44605 STANDARDS DEVELOPMENT PROCESS: RESOLUTION AND CONSENSUS. Johnson, Loering M.; Staff, P. E. (Combustion Engineering, Inc., Windsor, Conn.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 888-93 (Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The process of standards development is reviewed using the "Criteria for the Periodic Testing of Nuclear Power Generation Station Protection Systems" as an example. Areas considered include the need for a standard, the requirements of a standards document, draft preparation, and the obtaining of consensus and approval. Some of the problems of the consensus process are described. Responsibilities of the engineering community are reviewed. 18 references. (auth)

Physics and Core Engineering

Refer also to abstracts 44978 and 45035.

44606 ^{238}Pu PRODUCTION IN COMMERCIAL WATER REACTORS: ANALYTICAL AND EXPERIMENTAL PROGRAM. Roach, Kenneth E.; Mullett, William L. (Southern Nuclear Engineering, Inc., Dunedin, Fla.). Trans. Amer. Nucl. Soc.; 15: No. 1, 192-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44607 CRITICAL EXPERIMENTS WITH MIXED OXIDES OF Pu AND U CONTAINING 8 AND 30 WT. PERCENT PLUTONIUM. Bierman, S. R.; Clayton, E. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 307-9(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44608 THEORY-EXPERIMENT TESTS USING ENDF/B VERSION II CROSS-SECTION DATA. Hansen, L. E.; Clayton, E. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 309-10(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44609 ASPECTS OF THE GENERAL ELECTRIC COMPANY DEMONSTRATION PLANT CORE DESIGN. Pluta, P. R.; Greebler, P. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 331(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44610 STEAM ENTRY IN THE GCFR DEMONSTRATION PLANT. Broido, J. H.; Rothstein, M. P. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 355-6 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44611 STATISTICAL ANALYSIS OF IN-CORE MEASUREMENTS IN OPERATING NUCLEAR REACTORS. Fenech, H. (Univ. of California, Santa Barbara); Bales, G. R.; Flournoy, W. G. Trans. Amer. Nucl. Soc.; 15: No. 1, 364(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44612 OPTIMIZATION STUDIES OF LMFBR POWER PLANTS: OBJECTIVES. Zaleski, P.; Rafalovitch, A.; Guigou, J. (Electricite de France, Clamart). Trans. Amer. Nucl. Soc.; 15: No. 1, 378-80(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44613 OPTIMIZATION STUDIES OF LMFBR POWER STATIONS: OPTIMIZATION METHOD, MODEL OF THE PLANT. Zaleski, P.; Rafalovitch, A.; Guigou, J. (Electricite de France, Clamart). Trans. Amer. Nucl. Soc.; 15: No. 1, 380-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44614 NUCLEAR DESIGN OF THE C-E 500-MW(e) LMFBR DEMONSTRATION PLANT. Caspersson, Sten (Combustion Engineering Inc., Windsor, Conn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 393-4(Jun 1972).

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44615 DESIGN FEATURES OF THE GE-LMFBR DEMONSTRATION PLANT. Fidrych, L. F.; Billuris, G.; Rubinstein, H. J. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 394-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44616 EXPERIMENTAL VERIFICATION OF LUMPED BURNABLE POISON MODELS FOR PWR CORES. Green, I. D.; Wittkopf, W. A. (Babcock and Wilcox, Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 15: No. 1, 441-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44617 DECAY HEATING FROM ^{233}U, ^{235}U, ^{238}U, ^{232}Th, AND ^{239}Pu FISSION PRODUCTS. England, T. R.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 15: No. 1, 443-4(Jun 1972).

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44618 TRANSPORT EFFECTS ON LMFBR DOPPLER COEFFICIENTS. Kelber, Charles N. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 455(Jun 1972).

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44619 THEORETICAL NEUTRON-CAPTURE CALCULATIONS FOR ENDF/B AND THEIR UNCERTAINTIES. Schmittroth, F.; Schenter, R. E. (Westinghouse Hanford Co., Richland). Trans. Amer. Nucl. Soc.; 15: No. 1, 463-4(Jun 1972).

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44620 HETEROGENEITY EFFECTS IN THE MIT-BTF BLANKET NO. 2. Rogers, V. C. (Brigham Young Univ., Provo, Utah); Forbes, I. A.; Driscoll, M. J. Trans. Amer. Nucl. Soc.; 15: No. 1, 468(Jun 1972).

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44621 EFFECTIVE BETA MEASUREMENT BY A DETECTOR VARIANCE METHOD. Bennett, E. F.; Travelli, A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 488-9 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44622 FEEDBACK ANALYSIS BY ROD-DROP AND ROD-OSCILLATOR EXPERIMENT. Larson, H. A.; Engen, I. A.; Hyndman, R. W. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 495(Jun 1972).
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44623 SIMPLE COMPUTATIONAL MODEL FOR ROD MOTION TRANSIENTS. Diamond, D. J.; Lellouche, G. S.; Levine, M. M. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 495-6(Jun 1972).
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44624 MEASUREMENTS OF THE ^{238}U DOPPLER EFFECT IN BORON-POISONED ZONES IN AN LMFBR-TYPE CRITICAL ASSEMBLY. Bohn, E. M.; Meyer, J. F.; Pond, R. B. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 502-4(Jun 1972).
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44625 DISCREPANCY BETWEEN MEASURED AND CALCULATED CENTRAL REACTIVITY COEFFICIENTS. Karam, R. A.; Kato, W. Y. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 504-5(Jun 1972).
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44626 ERROR IN SMALL-SAMPLE REACTIVITY MEASUREMENTS DUE TO DELAYED-NEUTRON PARAMETER ASSUMPTIONS. Carpenter, S. G.; Goin, R. W. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 505(Jun 1972).
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44627 IN-CORE FAST-NEUTRON MEASUREMENTS USING A ^{3}He SEMICONDUCTOR SPECTROMETER. Glynn, James C. (Atomic Energy Commission, Washington, D. C.); Munno, Frank J.; Schroeder, Ivan G. Trans. Amer. Nucl. Soc.; 15: No. 1, 537(Jun 1972).
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44628 CALCULATION OF GAMMA HEATING IN A FAST REACTOR ENVIRONMENT. Stenstrom, D. G. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 551-2(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44629 BENCHMARK STUDY OF NEUTRON PENETRATION IN SODIUM. Su, Shiaw-der (Burns and Roe, Inc., Oradell, N. J.); Hungerford, Herbert E. Trans. Amer. Nucl. Soc.; 15: No. 1, 562(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Control and Instrumentation

Refer also to abstracts 43026 and 43191.

44630 OPTIMAL ROD PROGRAMMING AND LOADING PATTERN IN A MULTIREGION REACTOR. Motoda, Hiroshi; Kawai, Toshio; Kiguchi, Takashi (Hitachi Ltd., Kawasaki, Japan). Trans. Amer. Nucl. Soc.; 15: No. 1, 105-6(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44631 DEVELOPMENT OF A BWR SIMULATOR FACILITY IN AN ACADEMIC ENVIRONMENT. Christenson, J. M.; Emmerich, K. M.; Leonard, J. H.; Milton, J. D. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 15: No. 1, 127-8(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44632 DEVELOPMENT OF ANS PROPOSED STANDARD: EARTHQUAKE INSTRUMENTATION CRITERIA FOR NUCLEAR POWER PLANTS. Frankel, M. (Los Angeles Dept. of Water and Power). Trans. Amer. Nucl. Soc.; 15: No. 1, 318(Jun 1972).
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44633 REACTOR CONTROL: A STRUCTURAL-MODAL APPROACH. Changlai, Yi-shing; Ward, Thomas J. (Clarkson Coll. of Tech., Potsdam, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 363(Jun 1972).
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44634 SYSTEM FOR MEASURING VIBRATIONS OF NUCLEAR REACTOR INTERNAL STRUCTURES. Runde, H. A.; Kowles, J. E. (Combustion Engineering, Inc., Windsor, Conn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 364-5(Jun 1972).
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44635 LOW-LEVEL NEUTRON FLUX MONITORING SYSTEM FOR LMFBRs. Ackermann, N. J. Jr.; Roux, D. P.; Clay, W. T.; Guerrant, G. C. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 425(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44636 EVALUATION OF OPERATOR RESPONSE AT A MINIATURIZED CONTROL BOARD OF A LARGE POWER REACTOR. Raudenbush, M. H. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 426-7(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44637 B$_4$C CONTROL ROD WORTHS AND REACTION RATES, SODIUM-VOID WORTHS, AND ^{238}U DOPPLER EFFECTS NEAR B$_4$C CONTROL RODS IN A TYPICAL LMFBR CORE. Meyer, J. F.; Bohn, E. M.; Robinson, W. R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 501-2(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44638 CONTROL ROD SIGNAL MULTIPLEXING. Minor, G. C.; Moore, S. E. (General Electric Co., San Jose, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 789-92(Feb 1972).
From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

An application of multiplexing and system self-testing to the rod control and status-monitoring system of a Boiling Water Reactor (BWR) is described. The approach uses modularity at the field sensors with minimum interconnecting cables to the control room. The coding of the signal words employs error-detecting techniques to improve system reliability and availability. Fault diagnostics and identification improve the maintainability of the system. (auth)

44639 SHEATHED-THERMOCOUPLE-ELECTRODE-TYPE INSTRUMENTATION FOR LMFBR INDIVIDUAL SUBASSEMBLY MONITORING. Kuwabara, Jun; Kato, Yoshio (Japan Atomic Energy Research Inst., Tokai). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 793-806(Feb 1972).
From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Outlet temperature, channel flow-rate, boiling, fission-gas discharge and cover-gas entrainment can be detected from four wires of a pair of grounded-type sheathed chromel-alumel thermocouples inserted into the outlet open channel where magnetic flux traverses from a magnet circuit mounted inside the wrapper tube of individual subassembly of the liquid–metal-cooled fast breeder reactor. The modified conceptual design is presented. (auth)

44640 COMPOSITE TEMPERATURE–PRESSURE MEASUREMENT INSTRUMENT FOR ADVANCED REACTORS. Billeter, T. Roger (WADCO Corp., Richland, Wash.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 814-19(Feb 1972).
From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Operating theory and characteristics given concern a dual property measurement sensor and associated instrumentation for use with liquid metal cooled, fast breeder nuclear reactors. The sensor may also be applied in other similar severe environments. Pressure variations are sensed by deflection of a thin diaphragm which forms one end wall of a resonant cylindrical microwave cavity. Temperature changes cause the cavity size, and thus its resonant frequency to vary. Both physical properties may be continuously monitored as each relates to a distinct mode of cavity resonance. Precise digital readout of the resonant frequencies indicated a sensor sensitivity to pressure of about 9 MHz/psi (for null pressure scheme of operation), and to temperature of 350 kHz/°F. As both the sensor and connecting waveguide are entirely of metal, direct immersion in a liquid metal coolant should be possible. (auth)

44641 FAST DIGITAL REACTIVITY CALCULATION AND LOGGING SYSTEM. Lovallo, J. M.; Worsham, H. J. (Babcock and Wilcox Co., Lynchburg, Va.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 837-9(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

A portable digital system for rapid on-line calculation of reactivity during nuclear plant physics testing was designed and implemented. This system allows auxiliary data logging, formatting, and transmission to remote computer systems for further analysis. Provisions are made for operator displays as well as off-line computation within the system. (auth)

44642 SEPARATION IN THE BWR CONTROL ROOM. Schwartz, William G. (Sargent and Lundy Engineers, Chicago). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 865-72(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

To meet the single failure criterion of IEEE 279, Criteria for Nuclear Power Plant Protection Systems, physical separation requirements for electrical equipment and interconnecting cables must be established, preferably prior to the start of detailed plant design. These separation requirements must be adequate to insure that no single failure will prevent a sufficient number of safety-related components from performing their intended functions during the unlikely occurrence of a reactor accident, as well as during a less severe nuclear incident. However, these requirements must not be so stringent that they cannot be reasonably met by the designers and ultimately the plant constructors. General separation requirements which may initially appear to be simple, reasonable and quite adequate too often prove to be difficult, if not impossible, to meet in all aspects. Separation in the nuclear power plant control room complex is discussed. (auth)

44643 SEPARATION CRITERIA AND THEIR APPLICATION IN PWR CONTROL ROOM DESIGN. Haidinger, J.; Caine, A. P. (Bechtel Corp., San Francisco). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 873-82(Feb. 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The application of "Separation Criteria" in the design of a control room for a nuclear power plant whose prime mover is a pressurized water reactor (PWR) is discussed. The guidelines and requirements established in these separation criteria are built upon the requirements stated in IEEE "Criteria for Nuclear Power Plant Protection Systems," IEEE No. 279—1971 1), IEEE Criteria 308 2) and IEEE Separation Criteria SC-4. (auth)

44644 ASPECTS OF MINIATURIZATION IN A CONTROL ROOM OR GULLIVER EXPLORES NUCLEAR BROBDINGRAD AND LILLIPUT. Klein, R. L.; Summers, W. A. (Ebasco Services Inc., New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 877-82(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Examining nuclear boards from an unfettered viewpoint suggests that significant advances can be made by applying lessons learned in the last 20 years in conventional plants. Drastic reduction in the number of operating steps required at the control board, consolidation and timesharing of memory serviced operating displays and operator-oriented use of arm-reach space appear desirable. (auth)

Containment Systems, Waste Processing, and Radiation Protection

Refer also to abstract 44769.

44645 RADWASTE SYSTEM DESIGN AND OPERATION. Wright, J. H.; Von Hollen, H. J.; Vachon, L. J.; Terrill, J. G. Jr. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 320-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44646 DRY SITE RADWASTE SYSTEM DESIGN. Lee, Jay Y.; Wilson, Robert L. (Sacramento Municipal Utility District, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 321(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44647 PERFORMANCE EVALUATION OF A BWR PLANT LIQUID AND SOLID RADWASTE SYSTEM. Eliason, L. (Northern States Power Co., Minneapolis); Ross, C.; Lagache, M.; Vance, J. Trans. Amer. Nucl. Soc.; 15: No. 1, 322(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44648 CRYOGENIC SYSTEM FOR BWR GASEOUS RADWASTE TREATMENT. Winters, A. R.; Klosek, J.; Schmauch, G. E. (Air Products and Chemicals, Inc., Allentown, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 322-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44649 MODIFIED LAGRANGIAN METHOD FOR THE COMPUTATION OF REACTOR CONTAINMENT RESPONSE TO SLOW EXCURSIONS. Chang, Y. W.; Gvildys, J.; Marchertas, A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 359-60(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44650 TWO-DIMENSIONAL HYDRODYNAMIC CODE PRESSURE COMPUTATIONS FOR FAST REACTOR CONTAINMENT COMPARED WITH EXPERIMENTS. Ash, J. E.; Julke, R. T. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 360-1(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44651 DESIGN OF A REACTOR BUILDING VACUUM RELIEF SYSTEM. Beasley, E. Gray; Lau, L. Wang (Tennessee Valley Authority, Chattanooga). Trans. Amer. Nucl. Soc.; 15: No. 1, 395(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44652 TRITIUM TRANSPORT IN LMFBRs. Taylor, G. R.; Peters, F. E. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 431-2(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44653 EVALUATED CROSS-SECTION LIBRARY FOR FAST REACTOR SHIELD ANALYSES. Boulette, E. T.; Marr, D. R. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 525-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44654 ORDERS-OF-SCATTERING CALCULATIONS AND MEASUREMENTS, PENETRATION OF POLYENERGETIC NEUTRONS THROUGH SLABS OF STEEL AND WATER. Meyer, Walter (Kansas State Univ., Manhattan); Thiesing, J. W.; Leighty, J. W. Trans. Amer. Nucl. Soc.; 15: No. 1, 563-4(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Coolant System

Refer also to abstracts 42903, 43021, and 43168.

44655 (TID-3334(Pt.2)) SODIUM TECHNOLOGY, 1962–1971. (Technical Information Center (AEC), Oak Ridge, Tenn.). Jun 1972. 1052p. Dep. NTIS.

The literature cited in Nuclear Science Abstracts (NSA) for the period 1962 through March 31, 1972 on sodium and NaK technology is presented. The emphasis of the literature covered is sodium as applied to nuclear reactor coolant technology. A subject index is included. (H.D.R.)

44656 NUCLEAR REACTOR CONTAINMENT AND NUCLEAR MATERIALS FRACTURE TOUGHNESS STANDARDS. Steele, L. E. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 15: No. 1, 225-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44657 BEHAVIOR OF IODINE IN SODIUM SYSTEMS. Cooper, M. H.; Grundy, B. R.; Taylor, G. R. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 232-3 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44658 TRANSPORT OF ^{60}Co IN FLOWING, NONISOTHERMAL SODIUM. Roy, Prodyot (General Electric Co., San Jose,

Calif.); Dutina, Dragomir; Armijo, Sam. Trans. Amer. Nucl. Soc.; 15: No. 1, 233-4(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44659 FISSION PRODUCT REMOVAL FROM SODIUM BY HYDRIDE SLAGGING. Colburn, R. P. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 235-6(Jun 1972).
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44660 NEW DESIGN CRITERIA FOR FLOW-INDUCED VIBRATIONS OF VESSEL INTERNALS. Moretti, P. M. (Oklahoma State Univ., Stillwater). Trans. Amer. Nucl. Soc.; 15: No. 1, 338(Jun 1972).
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44661 EFFECT OF GAS/VAPOR BLANKETING ON PRESSURE PULSES AND MECHANICAL WORK PRODUCED BY MOLTEN FUEL/COOLANT INTERACTIONS. Cho, D. H. (Argonne National Lab., Ill); Kazimi, M. S.; Chen, W. L. Trans. Amer. Nucl. Soc.; 15: No. 1, 344-5(Jun 1972).
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44662 FRAGMENTATION OF MOLTEN JETS. Bradley, R. H. (Manned Spacecraft Center, Houston, Tex.); Witte, L. C. Trans. Amer. Nucl. Soc.; 15: No. 1, 345-6(Jun 1972).
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44663 NUMERICAL CALCULATION OF VOIDING FOLLOWING AN LMFBR SUBASSEMBLY BLOCKAGE. Bohl, W. R.; Dunn, F. E.; Heames, T. J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 351(Jun 1972).
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44664 EVALUATION OF DRYOUT AND FLOW INSTABILITY IN THE WAKE DOWNSTREAM OF A BLOCKAGE IN AN LMFBR SUBASSEMBLY. Fauske, Hans K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 351-2(Jun 1972).
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44665 COOLANT TEMPERATURE DOWNSTREAM OF A SUBASSEMBLY BLOCKAGE. Crawford, R. M.; Marr, W. W.; Padilla, A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 352-3(Jun 1972).
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44666 EFFECT OF PARTIAL FLOW BLOCKAGE ON INLET-FLOW REDISTRIBUTION. Sha, William T. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 353-4(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44667 PRESSURE-PULSE PROPAGATION FOLLOWING A MOLTEN FUEL-COOLANT INTERACTION IN PIPING NETWORKS. Chen, W. L. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 361-2(Jun 1972).
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44668 DRY HEAT REJECTION SYSTEMS. Steigelmann, William H.; Seth, R. G.; Boardman, G. R. (Franklin Inst. Research Labs., Philadelphia). Trans. Amer. Nucl. Soc.; 15: No. 1, 376-7(Jun 1972).
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44669 SIMULATION OF THE CAVITATION OF A VARIABLE-SPEED CENTRIFUGAL PUMP FOLLOWING SUDDEN LOAD REMOVAL. Martin, J. K.; Additon, S. L. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 391 (Jun 1972).
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44670 DESIGN OPTIMIZATION OF THE MAIN COOLING WATER SYSTEMS FOR A PRESSURIZED WATER REACTOR PLANT. Bartoli, H. E. (Burns and Roe, Inc., Oradell, N. J.); Stamper, E. Trans. Amer. Nucl. Soc.; 15: No. 1, 392-3(Jun 1972).
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44671 FLOW SIMULATION OF A BLOCKED ASSEMBLY. Esposito, V. J. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 402-3(Jun 1972).
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44672 FREE CONVECTION DISTORTION AND EDDY DIFFUSIVITY EFFECTS IN TURBULENT MERCURY HEAT TRANSFER. Jacoby, J. K.; Sesonske, Alexander (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc.; 15: No. 1, 408-9 (Jun 1972).
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44673 INCIPIENT-BOILING SUPERHEAT IN A CONVECTIVE SODIUM SYSTEM. Henry, Robert E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 410-11(Jun 1972).
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44674 TRANSIENT NONBOILING FORCED-CONVECTION HEAT TRANSFER. Stein, Ralph P. (Argonne National Lab., Ill.); Nelson, Martin E. Trans. Amer. Nucl. Soc.; 15: No. 1, 411(Jun 1972).
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44675 PRESSURE DROP CALCULATIONS IN BWR ROD BUNDLES. Marinelli, V.; Pastori, L. (CNEN, Rome). Trans. Amer. Nucl. Soc.; 15: No. 1, 412-13(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44676 EXPERIMENTAL INVESTIGATION ON MASS VELOCITY DISTRIBUTION AND VELOCITY PROFILES IN AN LWR ROD BUNDLE. Marinelli, V. (CNEN, Rome); Pastori, L.; Kjellen, B. Trans. Amer. Nucl. Soc.; 15: No. 1, 413-15(Jun 1972).
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44677 CRITICAL FLOW OF SATURATED LIQUID THROUGH SHORT TUBES. Prisco, Michael R. (Argonne National Lab., Ill.); Henry, Robert E.; Linehan, John H. Trans. Amer. Nucl. Soc.; 15: No. 1, 416-17(Jun 1972).
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Fuels and Fuel Elements

Refer also to abstracts 42704, 44947, and 44948.

44678 INDIFFERENCE VALUE OF PLUTONIUM. Spierling, Herbert; Benedict, Manson; Mason, Edward A. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 15: No. 1, 110-11(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44679 VALUE OF RECYCLE PLUTONIUM IN PRESSURIZED WATER REACTORS. Spierling, Herbert; Benedict, Manson; Mason, Edward A. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 15: No. 1, 111-12(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44680 EVALUATION OF ALTERNATIVE SOLUTIONS FOR PLUTONIUM UTILIZATION IN LIGHT-WATER REACTORS. Ariemma, A.; Gualandi, M. Paoletti; Rosa, I.; Zaffiro, B. (ENEL, Rome). Trans. Amer. Nucl. Soc.; 15: No. 1, 112-13(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44681 APPLICATION OF STATISTICS TO THE EBR-II DRIVER FUEL PROGRAM. Olson, N. J.; Walter, C. M. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 182(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44682 LMFBR FUEL ROD DESIGN USING MONTE CARLO TECHNIQUES. Atcheson, D. B.; Temme, M.; Orr, G. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 182-3(Jun 1972).

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44748 COMPARISON OF SAS2A SODIUM BOILING ANALYSIS WITH EXPERIMENT. Dunn, F. E.; Hoppner, G.; Heames, T. J.; Fischer, G. J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 15: No. 1, 340-1(Jun 1972).
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44750 EMERALD: A PROGRAM FOR CALCULATING RADIATION DOSES FROM PRESSURIZED WATER PLANT. Brunot, W. K. (Pacific Gas and Electric Co., San Francisco). Trans. Amer. Nucl. Soc.; 15: No. 1, 550-1(Jun 1972).
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Steam and Power Conversion System

44751 IMPROVED BINARY CYCLES FOR HTGRS. McCraken, Kenneth W. (Kirkland Air Force Base, Albuquerque, N. Mex.); Rust, James H.; Miller, Rodney. Trans. Amer. Nucl. Soc.; 15: No. 1, 371-2(Jun 1972).
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44752 EFFECT OF AN OSCILLATING DRYOUT POINT ON EVAPORATOR TUBE LIFETIME. Lasarev, M. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 396-7(Jun 1972).
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44753 METHOD OF DETERMINING MISSILE IMPACT PROBABILITY. Semanderes, Stavros N. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 15: No. 1, 401-2(Jun 1972).
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44754 ENVIRONMENTAL GAMMA RADIATION FROM ^{16}N IN REACTOR TURBINES. Lowder, Wayne M.; Raft, Peter D.;

Gogolak, Carl V. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 15: No. 1, 540-1(Jun 1972).

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Commercial Power Reactors

Refer also to abstract 42867.

44755 COMMERCIAL NUCLEAR POWER PLANTS. Edition No. 4, October 1971. Dunedin, Fla.; Southern Nuclear Engineering, Inc. (1971). 43p. $1.00.

A listing of basic information on commercial nuclear power plants in the United States is presented. The material, brought up to date to Oct. 1971, is presented alphabetically, by utility, with vacant columns provided for the reader's use in entering notes or data on new plants. (J.M.J.)

Physics and Core Engineering

44756 ANALYSIS OF A PLUTONIUM RECYCLE FUEL ASSEMBLY FOR THE YANKEE (ROWE) PWR. Mertens, P. G.; Lanning, D. D. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 15: No. 1, 109-10(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Control and Instrumentation

44757 (DOCKET-50244-104) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Loss of Power to Control Rods. (Rochester Gas and Electric Corp., N. Y.). 30 Jun 1972. 2p. Dep. NTIS.

44758 (DOCKET-50293-79) PILGRIM NUCLEAR POWER STATION. Abnormal Occurrence AO-72-2. (Boston Edison Co., Mass.). 3 Jul 1972. 4p. Dep. NTIS.

A reactor water level instrument indicator stuck at full scale during startup preparations at the Pilgrim Power Reactor. The indicator was freed, and repeated cycling of the instrument showed no abnormal operation. Subsequent investigation resulted in repair of the instrument and a program to lubricate like instruments during calibration tests. (H.D.R.)

44759 DESIGN AND OPERATION EXPERIENCE WITH CONTROL AND INSTRUMENTATION SYSTEMS: PEACH BOTTOM ATOMIC POWER STATION UNIT I. Dunning, T. G. (Gulf General Atomic Co., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 843-5(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Problems covering the design and operating experience with the control and instrumentation systems for the Peach Bottom Atomic Power Station Unit 1 are described. In general, the problems encountered during startup and operation do not reveal any new areas requiring special attention from a design standpoint. Rather, the experience reconfirms the known requirements for designing trouble-free instrumentation and control systems. Operations have shown relatively few instrumentation problems beyond those that fall under the category of normal maintenance. The control system response has closely matched the design predictions. The protection systems have responded, without failure, when required. False trips have not occurred except on a few occasions when problems occurred during routine testing. (auth)

44760 INSTRUMENTATION PROBLEMS AT THE MONTICELLO NUCLEAR GENERATING PLANT. Hill, William J. (Northern States Power Co., Monticello, Minn.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 846-50(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Some of the unusual instrumentation problems encountered during the startup of the Monticello Plant are described. These problems are as follows: (1) Moisture Separator Drain Tank Level Control Problems. (2) Protection System Relay Failures. (3) Setpoint Drift of Protection System Vacuum Switches. (4) False High Pressure Coolant Injection System Steam Flow Signals. (5) Instrument Manifold Valve Problems. (auth)

44761 SOLID-STATE PLANT PROTECTION SYSTEM FOR A COMMERCIAL POWER REACTOR. Block, G. A. (Gulf General Atomic, San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 851-9(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

The plant protection system for the Fort St. Vrain Nuclear Generating Station is described. A number of unique problems which were resolved during the detailed design of the hardware and circuitry are discussed. (H.D.R.)

44762 CONTROL ROOM DESIGN AT MAINE YANKEE. Beckley, Bruce B. (Maine Yankee Atomic Power Co., Wiscasset). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 860-4(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Containment Systems, Waste Processing, and Radiation Protection

44763 (DOCKET-50155-116) BIG ROCK POINT NUCLEAR PLANT. Off-Gas Isolation Valve Failed to Close Completely. (Consumers Power Co., Jackson, Mich.). 26 Jun 1972. 2p. Dep. NTIS.

44764 (DOCKET-50312-44) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Report on Inward Bulges of Containment Liner Plate. (Sacramento Municipal Utility District, Calif.). 6 Jun 1972. 19p. Dep. NTIS.

44765 PCRV PRESSURE AND LEAKAGE TEST AT FORT ST. VRAIN. Barker, R. A. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 387-8(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Coolant System

44766 (DOCKET-50155-118) BIG ROCK POINT NUCLEAR PLANT. Technical Specification, Proposed Change 32. (Consumers Power Co., Jackson, Mich.). 30 Jun 1972. 14p. Dep. NTIS.

A change to the technical specifications for the Big Rock Point plant is proposed to specify the primary coolant recirculation system leak detection limits. (H.D.R.)

44767 (DOCKET-50289-59) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Significant Deficiency/Thin Walled Valves. (Metropolitan Edison Co., Reading, Pa.). 7 Jun 1972. 3p. Dep. NTIS.

44768 HELIUM CIRCULATOR TESTING EXPERIENCE AT FORT ST. VRAIN. Colgan, G. T. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 388(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44769 HOT FUNCTIONAL TEST RESULTS. Nelson, R. G. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 389(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44770 OPERATING AND DESIGN EXPERIENCE WITH CONTROL AND INSTRUMENTATION SYSTEMS AT SAN ONOFRE NUCLEAR GENERATING STATION. Santosuosso, Ronald N. (Southern California Edison Co., Rosemead). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 1, 840-2(Feb 1972).

From Nuclear science symposium; San Francisco, Calif. (3 Nov 1971). See CONF-711111.

Operating and design experiences with the Control Rod Position System, Nuclear Instrumentation System and Resistance Temperature Detectors at the San Onofre Nuclear Generating Station are discussed. Methods used to locate and solutions for each problem are discussed. An approach to prove reliability of Resistance Temperature Detectors before installation is described. (auth)

Fuels and Fuel Elements

44771 (DOCKET-50244-105) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Fuel Abnormalities at the R. E. Ginna Plant and other Operating PWRs. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). 30 Jun 1972. 20p. Dep. NTIS.

44772 APPLICATION OF IN-CORE FUEL MANAGEMENT TECHNIQUES. Cherry, B. H.; Bond, G. R. (General Public

Utilities Corp., Parsippany, N. J.); Ross, D. A.; Growney, E. J. Trans. Amer. Nucl. Soc.; 15: No. 1, 100(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44773 NUCLEAR FUEL MANAGEMENT. Veras, A. F. (Commonwealth Edison Co., Chicago). Trans. Amer. Nucl. Soc.; 15: No. 1, 100-1(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44774 TECHNICAL ASPECTS OF NUCLEAR FUEL MANAGEMENT: TENNESSEE VALLEY AUTHORITY PREPARATIONS. Davidson, R. H. (Tennessee Valley Authority, Chattanooga). Trans. Amer. Nucl. Soc.; 15: No. 1, 101-2(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44775 OPERATIONS-ORIENTED FUEL MANAGEMENT SYSTEM. Ross, D. (Jersey Central Power and Light Co., Forked River, N. J.); Growney, E.; Zodiaco, V.; Fisher, J.; Kendrick, E. Trans. Amer. Nucl. Soc.; 15: No. 1, 102-3(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44776 IN-CORE FUEL MANAGEMENT AT THE YANKEE ATOMIC ELECTRIC COMPANY. Beck, J. W. (Yankee Atomic Electric Co., Westborough, Mass.). Trans. Amer. Nucl. Soc.; 15: No. 1, 104(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44777 FUEL MANAGEMENT WITH LUMPED BURNABLE POISON. Jones, Henry M.; Thompson, Steve; Tulenko, J. S. (Babcock and Wilcox, Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 15: No. 1, 104-5(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44778 IRRADIATION OF PLUTONIUM ASSEMBLIES IN THE DODEWAARD BWR POWER PLANT. Deramaix, P. (Belgonucleaire S. A., Brussels); Andriessen, H.; Bairiot, H.; Charlier, A.; Leenders, L.; Mostert, P. Trans. Amer. Nucl. Soc.; 15: No. 1, 113-14(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Auxiliary Systems and Engineered Safeguards

44779 (DOCKET-50155-115) BIG ROCK POINT NUCLEAR PLANT. Diesel Generator Failed to Start May 25, 1972 on Routine Weekly Test. (Consumers Power Co., Jackson, Mich.). 23 Jun 1972. 1p. Dep. NTIS.

44780 (DOCKET-50249-140) DRESDEN NUCLEAR POWER STATION, UNIT 3. Failure of a Reactor Protection Limit Switch on Number 2 Turbine Control Valve. (Commonwealth Edison Co., Morris, Ill. (USA)). 10 Jul 1972. 1p. Dep. NTIS.

44781 (DOCKET-50254-101) QUAD-CITIES STATION, UNIT 1. Final Injection Valve MO-1-1301-49 Failed to Open. (Commonwealth Edison Co., Cordova, Ill.). 3 Jul 1972. 1p. Dep. NTIS.

44782 (DOCKET-50266-72) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Diesel Generator Bearing Supports. (Wisconsin Electric Power Co., Milwaukee). 30 Jun 1972. 2p. (DOCKET-50301-63). Dep. NTIS.

44783 ECCS RETROFIT HOT MAINTENANCE EXPERIENCE IN DRESDEN UNIT NO. 1. Worden, William P. (Commonwealth Edison Co., Chicago); Stouky, R. J. Trans. Amer. Nucl. Soc.; 15: No. 1, 433(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44784 YANKEE BACKFITTING EXPERIENCE. Wiot, E. R. (Yankee Atomic Electric Co., Westborough, Mass.). Trans. Amer. Nucl. Soc.; 15: No. 1, 439(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44785 BIG ROCK POINT BACKFITTING EXPERIENCE. Sewell, Ralph B. (Consumer Power Co., Jackson, Mich.). Trans. Amer. Nucl. Soc.; 15: No. 1, 439-40(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44786 CONSOLIDATED EDISON COMPANY UNITS NO. 1, 2, AND 3. Prestele, J. A. (N. Y. Consolidated Edison Co., New York). Trans. Amer. Nucl. Soc.; 15: No. 1, 440(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44787 BACKFITTING EXPERIENCE AT THE SAXTON REACTOR. Montgomery, C. R. (Saxton Nuclear Experimental Corp., Reading, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 440(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Operation and Economics

44788 (DOCKET-50003-117) INDIAN POINT STATION, UNIT 1. Changes in Procedures to Prevent Recurrence of Containment Isolation Valve Problem. (Consolidated Edison Co. of New York, Inc., New York). 10 Jul 1972. 2p. Dep. NTIS.

44789 (DOCKET-50016-159) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Water Present in Fuel Storage Tank for Diesel Generator. (Power Reactor Development Co., Detroit, Mich.). 26 Jun 1972. 2p. Dep. NTIS.

44790 (DOCKET-50016-161) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Report for February 1972. (Power Reactor Development Co., Detroit, Mich.). 7 Jul 1972. 14p. (PRDC-EF-102). Dep. NTIS.

44791 (DOCKET-50016-162) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Report for March 1972. (Power Reactor Development Co., Detroit, Mich.). Mar 1972. 14p. (PRDC-EF-103). Dep. NTIS.

44792 (DOCKET-50029-188) YANKEE NUCLEAR POWER STATION. Operation Report 137 for Month of May 1972. (Yankee Atomic Electric Co., Westboro, Mass.). 22 Jun 1972. 11p. Dep. NTIS.

44793 (DOCKET-50146-110) SAXTON NUCLEAR EXPERIMENTAL REACTOR PROJECT. Removal of Fuel Completed June 30, 1972. (Saxton Nuclear Experimental Corp., Pa.). 12 Jul 1972. 1p. Dep. NTIS.

44794 (DOCKET-50171-105) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. 66 Pounds of He Containing 14mCI of ^{85}Kr Inadvertently Released from Stack. (Philadelphia Electric Co., Pa.). 11 Jul 1972. 2p. Dep. NTIS.

44795 (DOCKET-50206-158) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report for the Month of November 1971. (Southern California Edison Co., Rosemead, Calif.). Nov 1971. Contract AT(30-1)-3270. 8p. (NYO-3270-56). Dep. NTIS.

44796 (DOCKET-50206-159) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report for the Month of December 1971. (Southern California Edison Co., Rosemead, Calif.). Dec 1971. Contract AT(11-1)-3526. 6p. (COO-3526-57). Dep. NTIS.

44797 (DOCKET-50206-160) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report for the Month of January 1972. (Southern California Edison Co., Rosemead, Calif.). Jan 1972. Contract AT(11-1)-3526. 9p. (COO-3526-58). Dep. NTIS.

44798 (DOCKET-50206-161) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report for the Month of February 1972. (Southern California Edison Co., Rosemead, Calif.). Feb 1972. Contract AT(11-1)-3526. 9p. (COO-3526-59). Dep. NTIS.

44799 (DOCKET-50206-162) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report for the Month of March 1972. (Southern California Edison Co., Rosemead, Calif.). Mar 1972. Contract AT(11-1)-3526. 6p. (COO-3526-60). Dep. NTIS.

44800 (DOCKET-50206-163) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report for the Month of April 1972. (Southern California Edison Co., Rosemead, Calif.). Apr 1972. Contract AT(11-1)-3526. 7p. (COO-3526-61). Dep. NTIS.

44801 (DOCKET-50206-164) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report for the Month of

June 1972. (Southern California Edison Co., Rosemead, Calif.). Jun 1972. Contract AT(11-1)-3526. 7p. (COO-3526-63). Dep. NTIS.

44802 (DOCKET-50213-143) HADDAM NECK PLANT, UNIT 1. Operation Report No. 72-5, May 1972. (Connecticut Yankee Atomic Power Co., Haddam). 23 Jun 1972. Contract AT(30-1)-3144. 16p. (NYO-3144-72). Dep. NTIS.

44803 (DOCKET-50213-145) HADDAM NECK PLANT, UNIT 1. Action Taken to Correct Item of Noncompliance Brought to Attention Following Inspection of May 2-4, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 23 Jun 1972. 6p. Dep. NTIS.

Additional information is presented concerning performance testing procedures for nuclear instrumentation. (D.C.C.)

44804 (DOCKET-50219-195) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Action Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on February 23, 24, 25, 29, and March 1, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 16 Jun 1972. 7p. Dep. NTIS.

Requested additional information is presented concerning the operating requirements for emergency diesel generators, and the reporting requirements for abnormal occurrences. (D.C.C.)

44805 (DOCKET-50219-198) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Trip of Diesel Generator No. 1. (Jersey Central Power and Light Co., Morristown, N. J.). 30 Jun 1972. 2p. Dep. NTIS.

44806 (DOCKET-50220-99) NINE MILE POINT NUCLEAR STATION, UNIT 1. Petition for Conversion from Provisional Operating License to Full-Term Operating License. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Jul 1972. 164p. Dep. NTIS.

44807 (DOCKET-50237-242) DRESDEN NUCLEAR POWER STATION, UNIT 2. Two Valves Failed to Operate. (Commonwealth Edison Co., Chicago, Ill.). 23 Jun 1972. 2p. Dep. NTIS.

44808 (DOCKET-50245-136) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence, AO-72-16. (Millstone Point Co., Hartford, Conn.). 5 Jul 1972. 1p. Dep. NTIS.

The failure of an isolation condenser steam supply high flow switch to trip within the allowable range is described. (D.C.C.)

44809 (DOCKET-50245-137) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Proposed Change 7. (Millstone Point Co., Hartford, Conn.). 12 Jul 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning actuation of the automatic pressure relief valves during instrumentation modifications for the gas turbine generator. (D.C.C.)

44810 (DOCKET-50249-142) DRESDEN NUCLEAR POWER STATION, UNIT 3. Reactor Protection System Limit Switch on No. 2 Turbine Control Valve Found to be Inoperable. (Commonwealth Edison Co., Chicago, Ill.). 17 Jul 1972. 2p. Dep. NTIS.

44811 (DOCKET-50254-102) QUAD-CITIES STATION, UNITS 1 AND 2. Request Authorization for Continuous Operation of Each Unit of 2260 MW(t). (Commonwealth Edison Co., Chicago, Ill.). 7 Jul 1972. 11p. (DOCKET-50265-89). Dep. NTIS.

44812 (DOCKET-50263-130) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Failure of a Control Rod Drive to Fully Insert During a Scram. (Northern States Power Co., Minneapolis, Minn.). 19 Jun 1972. 2p. Dep. NTIS.

44813 (DOCKET-50263-132) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Lapse of Off Gas Monitoring. (Northern States Power Co., Minneapolis, Minn.). 30 Jun 1972. 2p. Dep. NTIS.

44814 (DOCKET-50263-133) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Low Discharge Head on "A" Loop RHR Service Water Pumps. (Northern States Power Co., Minneapolis, Minn.). 3 Jul 1972. 6p. Dep. NTIS.

44815 (DOCKET-50263-135) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Changes on 1971 Annual of Radioactive Effluents and Six Months Operating Report (July-December 1971). (Northern States Power Co., Minneapolis, Minn.). 6 Jul 1972. 1p. Dep. NTIS.

44816 (DOCKET-50265-86) QUAD-CITIES STATION, UNIT 2. Failure of Electromatic Relief Valve to Open on Signal. (Commonwealth Edison Co., Cordova, Ill.). 29 Jun 1972. 4p. Dep. NTIS.

44817 (DOCKET-50265-87) QUAD-CITIES STATION, UNIT 2. Failure of Essential Service Motor Generator Set Due to Dirty Contacts. (Commonwealth Edison Co., Cordova, Ill.). 26 Jun 1972. 1p. Dep. NTIS.

44818 (DOCKET-50266-71) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Failure of Circuit Breaker Overcurrent Trip Delay Device. (Wisconsin Electric Power Co., Milwaukee). 27 Jun 1972. 1p. (DOCKET-50301-62). Dep. NTIS.

44819 (DOCKET-50271-87) VERMONT YANKEE NUCLEAR POWER STATION. Operations Report No. 72-4, April 1972. (Vermont Yankee Nuclear Power Corp., Rutland). 30 Jun 1972. 21p. Dep. NTIS.

44820 (DOCKET-50271-89) VERMONT YANKEE NUCLEAR POWER STATION. Operation Report 72-5, May 1972. (Vermont Yankee Nuclear Power Corp., Rutland). 6 Jul 1972. 21p. Dep. NTIS.

44821 (DOCKET-50336-34) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Deficiency Report 1. (Millstone Point Co., Hartford, Conn.). 12 May 1972. 2p. Dep. NTIS.

Damage to the pressure vessel closure head is described. (D.C.C.)

44822 (DOCKET-50373-23) LA SALLE COUNTY STATION, UNIT 1. Investigation of Cracked Recirculation Outlet Nozzle and Description of the Major Repair. (Combustion Engineering, Inc., Chattanooga, Tenn. Nuclear Components Engineering Dept.). 17 Jul 1972. 54p. Dep. NTIS.

For Commonwealth Edison Co., Chicago, Ill.

44823 (DOCKET-50409-3) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, May 1972. (Dairyland Power Cooperative, La Crosse, Wis.). May 1972. 31p. (DPC-851-43). Dep. NTIS.

44824 EFFECT OF PLANT CLUSTERING ON ELECTRIC POWER COST. Jacobson, L. D. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 371 (Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44825 LP OPTIMIZATION MODEL FOR FORECASTING NUCLEAR POWER GROWTH PATTERNS. Little, W. W. Jr.; Hardie, R. W.; Black, W. E. (Westinghouse Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 15: No. 1, 372-3(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44826 SYSTEM INTEGRATION AND OPTIMIZATION MODEL FOR NUCLEAR POWER MANAGEMENT PLANNING. Deaton, Paul F.; Mason, Edward A. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 15: No. 1, 373-5(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44827 PARALLEL DERIVATION OF MARGINAL COSTS PERTINENT TO UTILITY SYSTEM OPTIMIZATION. Deaton, Paul F.; Mason, Edward A. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 15: No. 1, 375-6(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44828 COMMISSIONING FORT ST. VRAIN. Kantor, Martin E. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 387(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44829 PHYSICS STARTUP TEST PROGRAM FOR THE FORT ST. VRAIN HTGR. Brown, J. R.; Gillette, E. M.; Simon, W. A.; Van Howe, K. R. (Gulf General Atomic, San Diego, Calif.). Trans. Amer. Nucl. Soc.; 15: No. 1, 389-90(Jun 1972).

From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Safety and Siting

Refer also to abstracts 43291 and 43292.

44830 (DOCKET-1151-56) ELK RIVER REACTOR. Confirmation and Clarification of TWX Dated June 15, 1972. (United Power Association, Elk River, Minn. (USA)). 20 Jun 1972. 2p. Dep. NTIS.
A notification is presented of an intention to load dismantled parts of the Elk River reactor pressure vessels into shipping casks in air rather than underwater. (H.D.R.)

44831 (DOCKET-50003-116) INDIAN POINT STATION, UNIT 1. Facility Tripped Out of Service on June 17, 1972. (Consolidated Edison Co. of New York, Inc., New York). 27 Jun 1972. 2p. Dep. NTIS.

44832 (DOCKET-50010-112) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. QUAD-CITIES STATION, UNITS 1 AND 2. Commonwealth Edison Company Generating Stations Emergency Plan. (Commonwealth Edison Co., Chicago, Ill.). 12 May 1972. 150p. (DOCKET-50237-243; DOCKET-50249-139; DOCKET-50254-100; DOCKET-50265-88). Dep. NTIS.

44833 (DOCKET-50029-186) YANKEE NUCLEAR POWER STATION. Action Taken to Correct Items of Noncompliance Brought to Attention Following February 16-18, 1972 Inspection. (Division of Compliance (AEC), Newark, N. J. Region I). 8 Jun 1972. 15p. Dep. NTIS.
Various procedures at Yankee Power Reactor in the areas of quality assurance and surveillance testing are discussed. (H.D.R.)

44834 (DOCKET-50029-187) YANKEE NUCLEAR POWER STATION. Technical Specifications, Proposed Change 101. (Yankee Atomic Electric Co., Westboro, Mass.). 6 Jul 1972. 5p. Dep. NTIS.
Revised technical specifications are presented concerning control rod drop testing program. (D.C.C.)

44835 (DOCKET-50206-157) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis, Amendment 25. (Southern California Edison Co., Rosemead, Calif.). 28 Jun 1972. 310p. Dep. NTIS.
The FSAR is amended in response to requests for additional information concerning the San Onofre Power Reactor, Unit 1. (H.D.R.)

44836 (DOCKET-50213-144) HADDAM NECK PLANT, UNIT 1. Environmental Report, Operating License Stage. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 522p. Dep. NTIS.

44837 (DOCKET-50213-146) HADDAM NECK PLANT, UNIT 1. Environmental Report, Appendix A; Report to the New England Planning Committee. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 33p. Dep. NTIS.
The effects of a delay and shutdown of nuclear capacity on the New England bulk power supply reliability are examined. (H.D.R.)

44838 (DOCKET-50213-147) HADDAM NECK PLANT, UNIT 1. Environmental Report, Appendix B; Connecticut River Study. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 766p. Dep. NTIS.
Ecological and hydrological data for the Connecticut River are presented for the period from July 1965 to October 1971. (D.C.C.)

44839 (DOCKET-50213-148) HADDAM NECK PLANT, UNIT 1. Environmental Report, Appendix B, Addendum 1. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 36p. Dep. NTIS.
The major results of an intensive study of the ecology of the lower reaches of the tidal Connecticut River, U.S.A., 1965-1971, are presented. This study was undertaken to determine what effects the 828 cu.ft/sec (23,500 litres/sec, 373,000 gals/min) heated effluent (ΔT 22.4°F, 12.4°C) from a 590 MW electric generating station at Haddam Neck, Connecticut, would have on the aquatic biota of the region. The plant became operative in 1968, so precise before-and-after data are available for comparison. The study has included extensive observations on the hydrology, benthos, and ichthyofauna of the region. Brief accounts of concurrent microbiological and radiation monitoring studies are presented. Such ecological alterations as have been observed as a result of the local calefaction of the river appear to be relatively inconsequential. (auth)

44840 (DOCKET-50213-149) HADDAM NECK PLANT, UNIT 1. Environmental Report, Appendix C; Environmental Studies. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 602p. Dep. NTIS.
Radiological data for the reactor site are presented for the time period from October 1962 to June 1971. Meteorological data are included for October 1962 to December 1965. Temperature measurements for the Connecticut River are presented. (D.C.C.)

44841 (DOCKET-50213-151) HADDAM NECK PLANT, UNIT 1. Environmental Report, Appendix D; Permits and Approvals. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 65p. Dep. NTIS.

44842 (DOCKET-50213-153) HADDAM NECK PLANT, UNIT 1. Will be Operated Not to Exceed a Peak Heat Flux Factor of 2.47. (Connecticut Yankee Atomic Power Co., Hartford). 30 Jun 1972. 2p. Dep. NTIS.

44843 (DOCKET-50245-135) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Environmental Report, Errata and Addendum 1 to Appendix B. (Millstone Point Co., Hartford, Conn.). 23 Jun 1972. 556p. Dep. NTIS.

44844 (DOCKET-50245-138) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. LPCI Pipe Supports Have Shifted. (Millstone Point Co., Hartford, Conn.). 13 Jul 1972. 4p. Dep. NTIS.

44845 (DOCKET-50245-142) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Rod Worth Minimizer Operability. (Millstone Point Co., Hartford, Conn.). 14 Jul 1972. 6p. Dep. NTIS.

44846 (DOCKET-50247-75) INDIAN POINT NUCLEAR GENERATING UNIT 2. Order Extending Facility Operating License Expiration Date. (Directorate of Licensing (AEC), Washington, D. C.). 5 Jul 1972. 2p. Dep. NTIS.

44847 (DOCKET-50254-98) QUAD-CITIES STATION, UNIT 1. Vibration Instrumentation. (Commonwealth Edison Co., Chicago, Ill.). 20 Jun 1972. 3p. Dep. NTIS.

44848 (DOCKET-50254-103) QUAD-CITIES STATION, UNIT 1. Interim Report on Condenser Pump Room Modifications. (Commonwealth Edison Co., Chicago, Ill.). 10 Jul 1972. 15p. Dep. NTIS.

44849 (DOCKET-50254-106) QUAD-CITIES STATION, UNIT 1. Changes to the Interim Report on Condenser Pump Room Modifications. (General Electric Co., San Jose, Calif. Nuclear Energy Div.). 18 Jul 1972. 1p. Dep. NTIS.

44850 (DOCKET-50255-92) PALISADES PLANT. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1972. 470p. Dep. NTIS.
Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data on the reactor site are included. Cost-benefit analysis of reactor operations is presented. (D.C.C.)

44851 (DOCKET-50255-93) PALISADES PLANT. Repairs to Control Rod Drive Mechanism 35 and 39. (Consumers Power Co., Jackson, Mich.). 11 Jul 1972. 2p. Dep. NTIS.

44852 (DOCKET-50259-54) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 33. (Tennessee Valley Authority, Chattanooga). 22 Jun 1972. 34p. (DOCKET-50260-50; DOCKET-50296-47). Dep. NTIS.
Revised and additional information is presented concerning the radiological emergency plan and effects of site excavations on local flooding. (D.C.C.)

44853 (DOCKET-50259-55) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 34. (Tennessee Valley Authority, Chattanooga). 3 Jul 1972. 78p. (DOCKET-50260-51; DOCKET-50296-48). Dep. NTIS.
Revised and additional data are presented concerning the design parameters and operations aspects of the Browns Ferry Power Reactor Units 1, 2, and 3. (D.C.C.)

44854 (DOCKET-50259-56) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Steps Taken to Correct Items of Apparent Noncompliance Listed in Letters of March 30, 1972 and June 2, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 6 Jul 1972. 8p. (DOCKET-50260-52; DOCKET-50296-49). Dep. NTIS.

Additional information is presented concerning preoperational testing and hydrostatic leak testing procedures. (D.C.C.)

44855 (DOCKET-50261-100) H. B. ROBINSON UNIT 2. Control Rod Drop Incident. (Carolina Power and Light Co., Raleigh, N. C.). 30 Jun 1972. 1p. Dep. NTIS.

44856 (DOCKET-50263-131) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Summary Technical Report of Vibration Testing. (Northern States Power Co., Minneapolis, Minn.). 27 Jun 1972. 43p. Dep. NTIS.

44857 (DOCKET-50263-134) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Summary Report for Preoperational Tests and Startup Test Results. (Northern States Power Co., Minneapolis, Minn.). 30 Jun 1972. 238p. (NEDO-10563; 72-NED-35). Dep. NTIS.

44858 (DOCKET-50263-136) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Directorate of Regulatory Operations Bulletin 72-1, Failed Hangers for Emergency Core Cooling System Suction Header. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 22 Jun 1972. 8p. Dep. NTIS.

44859 (DOCKET-50265-90) QUAD-CITIES STATION, UNIT 2. Steps Taken to Correct the Items of Apparent Noncompliance Noted in Letter Dated June 15, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 10 Jul 1972. 9p. Dep. NTIS.

Inadequacies found during a quality assurance inspection at Quad-Cities Power Reactor, Unit 2, are presented. Corrective actions taken subsequent to the inspection are described. (H.D.R.)

44860 (DOCKET-50266-70) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Technical Specification, Request for Change. (Wisconsin Electric Power Co., Milwaukee). 21 Jun 1972. 2p. (DOCKET-50301-61). Dep. NTIS.

Revised technical specifications are presented concerning operating requirements for the redundant service water systems. (D.C.C.)

44861 (DOCKET-50269-57) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. B and W Topical Reports Incorporated Into Application as of June 26, 1972. (Duke Power Co., Charlotte, N. C.). 27 Jun 1972. 3p. (DOCKET-50270-45; DOCKET-50287-40). Dep. NTIS.

44862 (DOCKET-50269-58) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Steps Taken With Respect to Items Listed in Letter Dated June 2, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 11 Jul 1972. 7p. (DOCKET-50270-46; DOCKET-50287-41). Dep. NTIS.

Additional information is presented concerning revisions in the quality assurance program. (D.C.C.)

44863 (DOCKET-50269-59) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Steps Taken With Respect to the Items Noted in Letter Dated April 21, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 12 Jul 1972. 12p. (DOCKET-50270-47; DOCKET-50287-42). Dep. NTIS.

Information is presented concerning the elongation of stressed tendons in the reactor building. (D.C.C.)

44864 (DOCKET-50271-84) VERMONT YANKEE NUCLEAR POWER STATION. Action Taken to Correct the Item of Noncompliance Brought to Attention Following Inspection on March 17-19, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 30 May 1972. 9p. Dep. NTIS.

Quality assurance methods for the Vermont Yankee Power Reactor are discussed in relation to fuel pin identification and placement in fuel assemblies. (H.D.R.)

44865 (DOCKET-50271-85) VERMONT YANKEE NUCLEAR POWER STATION. Action Taken to Correct Item of Noncompliance Following Inspections on June 14-17, July 20, November 30, December 22, 1971, and January 18-21, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 3 Apr 1972. 15p. Dep. NTIS.

Inspection findings and corrective actions are discussed for a poor quality concrete problem, improper steel support structures in the switch yard, and a defective steam exhaust valve at the Vermont Yankee Power Reactor. (H.D.R.)

44866 (DOCKET-50271-86) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Class "B" and "C" Testing of the Containment. (Vermont Yankee Nuclear Power Corp., Rutland). 29 Jun 1972. 8p. Dep. NTIS.

44867 (DOCKET-50277-48) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Control of Combustible Gas Concentrations, Additional Information. (Philadelphia Electric Co., Pa.). 12 Jun 1972. 27p. (DOCKET-50278-48). Dep. NTIS.

Requested additional information is presented concerning the control of hydrogen and oxygen concentrations in the containment structures. (D.C.C.)

44868 (DOCKET-50277-49) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Environmental Report, Operating License Stage, Supplement 3. (Philadelphia Electric Co., Pa.). 28 Jun 1972. 51p. (DOCKET-50278-49). Dep. NTIS.

Additional information is presented concerning the effects on ecosystems of alternate chemical effluent, radioactive waste, and thermal discharge systems. (D.C.C.)

44869 (DOCKET-50277-50) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Environmental Report, Operating License Stage, Supplement 4. (Philadelphia Electric Co., Pa.). 7 Jul 1972. 12p. (DOCKET-50278-50). Dep. NTIS.

Requested additional information is presented concerning cost-benefit analysis, and chemical and thermal effluents from the reactors. (D.C.C.)

44870 (DOCKET-50281-73) SURRY POWER STATION, UNIT 2. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1972. 292p. Dep. NTIS.

44871 (DOCKET-50281-74) SURRY POWER STATION, UNIT 2. Order Extending Completion Date. (Directorate of Licensing (AEC), Washington, D. C.). 30 Jun 1972. 3p. Dep. NTIS.

44872 (DOCKET-50282-57) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Application for Licenses, Amendment 1, Supplement 1. (Northern States Power Co., Minneapolis, Minn.). 24 Aug 1967. 68p. (DOCKET-50306-55). Dep. NTIS.

The construction permit and operating license application for the Prairie Island Nuclear Generating Plant is amended to change the original application for a one-unit facility to an application for a two-unit facility. (H.D.R.)

44873 (DOCKET-50282-58) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 5. (Northern States Power Co., Minneapolis, Minn.). 25 Apr 1969. 68p. (DOCKET-50306-56). Dep. NTIS.

Requested additional information is presented concerning design parameters and operations aspects of the reactors. (D.C.C.)

44874 (DOCKET-50282-60) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Statement Why Construction Permits Should not be Suspended Pending Completion of NEPA Environmental Review, Supplementary Information. (Northern States Power Co., Minneapolis, Minn.). 9 Nov 1971. 4p. (DOCKET-50306-57). Dep. NTIS.

44875 (DOCKET-50282-61) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Safety Evaluation. (Division of Reactor Licensing (AEC), Washington, D. C.). 19 Apr 1968. 110p. (DOCKET-50306-58). Dep. NTIS.

44876 (DOCKET-50282-62) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Initial Decision. (Atomic Energy Commission, Washington, D. C. Atomic Safety and Licensing Board). 24 Jun 1968. 12p. (DOCKET-50306-59). Dep. NTIS.

Authorization is presented for issuance of provisional construction permits for the Prairie Island Power Reactor Units 1 and 2. (D.C.C.)

44877 (DOCKET-50282-63) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Basic Data for Source Term Calculations. (Northern States Power Co., Minneapolis, Minn.). 1 May 1972. 20p. (DOCKET-50306-60; NUS-TM-EP-7). Dep. NTIS.

Requested additional information is presented concerning radioactive effluents from the reactors. (D.C.C.)

44878 (DOCKET-50282-64) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 2, Revision. (Northern States Power Co., Minneapolis, Minn.). 15 Dec 1967. 594p. (DOCKET-50306-61). Dep. NTIS.

The preliminary safety analysis report for the Prairie Island Power Reactor, Units 1 and 2, is amended by the submission of revised and additional information. (H.D.R.)

44879 (DOCKET-50282-65) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 3, Revision. (Northern States Power Co., Minneapolis, Minn.). 15 Jan 1968. 153p. (DOCKET-50306-62). Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the Prairie Island Power Reactor Units 1 and 2. (D.C.C.)

44880 (DOCKET-50282-66) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Environmental Report, Supplement 2. (Northern States Power Co., Minneapolis, Minn.). 14 Jul 1972. 37p. (DOCKET-50306-63). Dep. NTIS.

Additional information is presented concerning the cost-benefit analysis for reactor operations. Chemical, radioactive, and thermal discharges from the reactors are discussed. (D.C.C.)

44881 (DOCKET-50285-66) FORT CALHOUN STATION, UNIT 1. Final Safety Analysis Report, Amendment 36. (Omaha Public Power District, Nebr.). 7 Jul 1972. 19p. Dep. NTIS.

Revised and additional data are presented concerning safety injection tanks for the engineered safeguards system. (D.C.C.)

44882 (DOCKET-50285-67) FORT CALHOUN STATION, UNIT 1. Environmental Radioactivity Surveillance Program, Pre-Operational Report, First Quarter 1972. (Omaha Public Power District, Nebr.). 10 Jul 1972. 26p. Dep. NTIS.

44883 (DOCKET-50289-60) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Containment Building Ring Girder Construction and Repair, Addendum 2. (Metropolitan Edison Co., Reading, Pa.). 30 Jun 1972. 96p. Dep. NTIS.

44884 (DOCKET-50293-76) PILGRIM NUCLEAR POWER STATION. Action to be Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on March 22-24, 1972 and April 3-5, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 31 May 1972. 11p. Dep. NTIS.

Activities related to the installation of electrical cable trays and conduits at the Pilgrim Power Reactor are discussed. (H.D.R.)

44885 (DOCKET-50293-77) PILGRIM NUCLEAR POWER STATION. Technical Basis for Accepting a Weld Surface Area with a Bluish Tint. (Division of Compliance (AEC), Newark, N. J. Region I). 31 May 1972. 6p. Dep. NTIS.

44886 (DOCKET-50293-78) PILGRIM NUCLEAR POWER STATION. Preoperational Environmental Radiation Survey Program. Quarterly Report, January 1-March 31, 1972. (Boston Edison Co., Mass.). 23 Jun 1972. 39p. Dep. NTIS.

44887 (DOCKET-50293-81) PILGRIM NUCLEAR POWER STATION. Unusual Occurrence June 15, 1972. (Boston Edison Co., Mass.). 7 Jul 1972. 3p. Dep. NTIS.

A plastic thread-protector from binoculars being used in the initial fueling of the Pilgrim Power Reactor was accidently lost in the core. Tests on a similar thread-protector and an evaluation of the consequences of the object remaining in the core indicate there will be no effects on the safe operation of the reactor. (H.D.R.)

44888 (DOCKET-50295-54) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Extending Provisional Construction Permit Completion Date. (Directorate of Licensing (AEC), Washington, D. C.). 26 Jun 1972. 2p. Dep. NTIS.

44889 (DOCKET-50295-55) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Notice of Consideration of Issuance of Facility Operating Licenses. (Directorate of Licensing (AEC), Washington, D. C.). 27 Jun 1972. 5p. (DOCKET-50304-54). Dep. NTIS.

44890 (DOCKET-50295-56) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1972. 202p. (DOCKET-50304-55). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

44891 (DOCKET-50298-44) COOPER NUCLEAR STATION. Steps Taken to Correct Items of Apparent Noncompliance Noted in Letter of June 2, 1972. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 11 Jul 1972. 5p. Dep. NTIS.

Additional information is presented concerning the installation of electrical cables. (D.C.C.)

44892 (DOCKET-50298-45) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 12. (Nebraska Public Power District, Columbus). 5 Jul 1972. 86p. Dep. NTIS.

The Cooper Nuclear Station safety analysis report is revised by the provision of clarifications to the original appendix on station nuclear safety operational analysis. (H.D.R.)

44893 (DOCKET-50302-50) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Compilation of Babcock and Wilcox Topical Reports Which Support Application for an Operating License. (Florida Power Corp., St. Petersburg). 30 Jun 1972. 3p. Dep. NTIS.

44894 (DOCKET-50305-43) KEWAUNEE NUCLEAR POWER PLANT. Environmental Report, Cost Benefit Analysis. (Wisconsin Public Service Corp., Green Bay). 23 Jun 1972. 76p. Dep. NTIS.

44895 (DOCKET-50313-43) ARKANSAS NUCLEAR ONE, UNIT 1. B and W Topical Reports Applicable to Arkansas Nuclear One, Unit 1. (Arkansas Power and Light Co., Little Rock). 20 Jun 1972. 4p. Dep. NTIS.

44896 (DOCKET-50315-66) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Ultrasonic Testing of Welds. (American Electric Power Service Corp., New York). 14 Jun 1972. 6p. (DOCKET-50316-66). Dep. NTIS.

44897 (DOCKET-50315-67) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 24. (Indiana and Michigan Power Co., New York). 5 Jul 1972. 106p. (DOCKET-50316-67). Dep. NTIS.

Revised design parameters of the Donald C. Cook Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactors requested by the Division of Reactor Licensing. (D.C.C.)

44898 (DOCKET-50317-51) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 22. (Baltimore Gas and Electric Co., Md.). 18 Jul 1972. 113p. (DOCKET-50318-49). Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the Calvert Cliffs Power Reactor Units 1 and 2. (D.C.C.)

44899 (DOCKET-50317-52) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 22; Site Emergency Plan, Revision 1. (Baltimore Gas and Electric Co., Md.). 19 Jul 1972. 15p. (DOCKET-50318-50). Dep. NTIS.

44900 (DOCKET-50321-47) EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2. Environmental Report, Supplement, Amendment 1, Errata Sheet 1. (Georgia Power Co., Atlanta). 4 May 1972. 2p. (DOCKET-50366-30). Dep. NTIS.

Corrected information concerning cost-benefit analysis data for the Edwin I. Hatch Power Reactor Units 1 and 2 is presented. (D.C.C.)

44901 (DOCKET-50331-50) DUANE ARNOLD ENERGY CENTER. Relief Valve Discharge Line. (Iowa Electric Light and Power Co., Cedar Rapids). 10 Jul 1972. 3p. Dep. NTIS.

44902 (DOCKET-50333-48) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Supplement 8. (Power Authority of the State of New York). 28 Jun 1972. 269p. Dep. NTIS.

The final safety analysis report for the James A. Fitzpatrick Power Reactor is supplemented by the submission of revised pages and responses to requests for additional information. (H.D.R.)

44903 (DOCKET-50333-49) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Effects of All Blowdown Forces Into the Torus on the Vent Pipe Anchorages. (Power Authority of the State of New York). 20 Jun 1972. 2p. Dep. NTIS.

44904 (DOCKET-50335-28) HUTCHINSON ISLAND PLANT, UNIT 1. Environmental Report, Supplement 4. (Florida Power and Light Co.). 27 Jun 1972. 11p. Dep. NTIS.

Requested additional information is presented concerning chemical discharges from the reactor. (D.C.C.)

44905 (DOCKET-50335–31) HUTCHINSON ISLAND PLANT, UNIT 1. Inspection of April 11–14, 1972 Revealed Several Items Which Appeared to be in Noncompliance with Quality Assurance Criteria. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 9 Jun 1972. 3p. Dep. NTIS.
Items of noncompliance with quality assurance criteria are described concerning welding procedures. (D.C.C.)

44906 (DOCKET-50336–33) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Environmental Report, Operating License Stage. (Millstone Point Co., Hartford, Conn.). 23 Jun 1972. 358p. Dep. NTIS.
The original environmental report for the Millstone Point Power Reactor, Unit 2, is amended by the submission of modified and supplemental material. (H.D.R.)

44907 (DOCKET-50341–39) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Cracks in the Basement Floor Slab of the Reactor Building. (Detroit Edison Co., Mich.). 12 May 1972. 4p. Dep. NTIS.

44908 (DOCKET-50341–40) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). 7 Jul 1972. 208p. Dep. NTIS.

44909 (DOCKET-50341–41) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Application for Licenses, Amendment 20. (Detroit Edison Co., Mich.). 19 Jul 1972. 3p. Dep. NTIS.
Revised completion dates are submitted for the construction permit and operating license applications. (D.C.C.)

44910 (DOCKET-50344–28) TROJAN NUCLEAR PLANT. Supplemental Environmental Report, Amendment 2. (Portland General Electric Co., Oreg.). 28 Jun 1972. 452p. Dep. NTIS.

44911 (DOCKET-50346–28) DAVIS–BESSE NUCLEAR POWER STATION. Environmental Report, Cost and Benefit Analysis Supplement. (Toledo Edison Co., Ohio). 6 Jul 1972. 171p. Dep. NTIS.

44912 (DOCKET-50354–24) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Reactor Pressure Vessel Fabrication Facility Audit. (Public Service Electric and Gas Co., Newark, N. J.). 18 May 1972. 5p. (DOCKET-50355–24). Dep. NTIS.

44913 (DOCKET-50363–28) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 17. (Jersey Central Power and Light Co., Morristown, N. J.). 23 Jun 1972. 59p. Dep. NTIS.
Revised and additional data are presented on the design and operation of the Forked River Power Reactor, Unit 1. (H.D.R.)

44914 (DOCKET-50363–29) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 18. (Jersey Central Power and Light Co., Morristown, N. J.). 30 Jun 1972. 242p. Dep. NTIS.
The preliminary safety analysis report of the Forked River Power Reactor, Unit 1, is amended by the submission of responses to requests for additional information. (H.D.R.)

44915 (DOCKET-50367–28) BAILLY GENERATING STATION, NUCLEAR I. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1972. 194p. Dep. NTIS.

44916 (DOCKET-50369–27) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Environmental Report, Supplement 5, Benefit-Cost Analysis. (Duke Power Co., Charlotte, N. C.). 11 Jul 1972. 6p. (DOCKET-50370–27). Dep. NTIS.
Revised and additional information is presented concerning thermal discharges from the reactors and cost-benefit analysis for operation. (D.C.C.)

44917 (DOCKET-50376–35) AGUIRRE NUCLEAR PLANT, UNIT 1. Environmental Report, Supplement 3. (Puerto Rico Water Resources Authority, San Juan). 12 Jul 1972. 605p. Dep. NTIS.

44918 (DOCKET-50382–26) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 18. (Louisiana Power and Light Co., New Orleans). 24 Jul 1972. 75p. Dep. NTIS.
Revised design parameters of the Waterford Power Reactor Unit 3 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

44919 (DOCKET-50395–21) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 9. (South Carolina Electric and Gas Co., Columbia). 29 Jun 1972. 149p. Dep. NTIS.
The preliminary safety analysis report for the Virgil C. Summer Power Reactor is amended by the submission of revised and additional information. (H.D.R.)

44920 (DOCKET-50395–23) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 11. (South Carolina Electric and Gas Co., Columbia). 21 Jul 1972. 29p. Dep. NTIS.
Revised and additional data are presented concerning design parameters and operations aspects of the Virgil C. Summer Power Reactor Unit 1. (D.C.C.)

44921 (DOCKET-50397–18) HANFORD NO. 2 NUCLEAR POWER PLANT. Environmental Report, Amendment 4. (Washington Public Power Supply System, Richland). 5 Jul 1972. 35p. Dep. NTIS.
Revised and additional information is presented concerning radioactive effluents from the reactor. (D.C.C.)

44922 (DOCKET-50398–13) MENDOCINO POWER PLANT, UNITS 1 AND 2. Environmental Report, Construction Permit Stage. Supplement, Volume I. (Pacific Gas and Electric Co., San Francisco, Calif.). Jun 1972. 330p. (DOCKET-50399–13). Dep. NTIS.

44923 (DOCKET-50398–14) MENDOCINO POWER PLANT, UNITS 1 AND 2. Environmental Report, Construction Permit Stage. Supplement, Volume II. (Pacific Gas and Electric Co., San Francisco, Calif.). May 1972. 661p. (DOCKET-50399–14). Dep. NTIS.

44924 NUCLEAR POWER PLANT LICENSING: A WORSENING PREDICAMENT. Dienhart, Arthur V. (Northern States Power Co., Minneapolis). Trans. Amer. Nucl. Soc.; 15: No. 1, 72(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44925 ISSUES IN NUCLEAR POWER PLANT COST-BENEFIT ANALYSIS. Kival, J. (Science Applications, Inc., La Jolla, Calif.); Barrett, M. J.; Battist, L. Trans. Amer. Nucl. Soc.; 15: No. 1, 74(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Propulsion and Auxiliary Power Reactors

44926 ZIRCONIUM HYDRIDE SPACE POWER REACTOR. Asquith, J. G. (Atomics International, Canoga Park, Calif.); Migra, R.; Stamp, S. R. Trans. Amer. Nucl. Soc.; 15: No. 1, 3-4(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44927 SMALL 1400°K REACTOR FOR BRAYTON SPACE POWER SYSTEMS. Lantz, Edward; Mayo, Wendell (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 1, 4-5(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44928 NUCLEAR POWER FOR THE C-5 TRANSPORT AIRCRAFT. Mills III, K. Louis; Meem, J. L. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 15: No. 1, 5(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44929 EFFECT OF FUEL DISTRIBUTION ON THE PERFORMANCE OF THE COLLOID CORE REACTOR. Kyslinger, J. A.; Ravets, J. M. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc.; 15: No. 1, 6(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44930 GAS-CORE REACTOR POWER TRANSIENT ANALYSIS. Kascak, Albert F. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 1, 6-7(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44931 GAMMA HEATING IN A GAS CORE ROCKET REFLECTOR. Lofthouse, J. H.; Kunze, J. F.; Young, R. C.; Young,

T. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 15: No. 1, 7-8(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44932 DESIGN PARAMETERS FOR A ROTATING-BED REACTOR-POWERED ROCKET ENGINE. Ludewig, Hans (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 15: No. 1, 8-9(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44933 POST-IMPACT BEHAVIOR OF MOBILE REACTOR CORE CONTAINMENT SYSTEMS. Puthoff, Richard L. (Louis Research Center, Cleveland); Parker, W. G.; Van Bibber, L. E. Trans. Amer. Nucl. Soc.; 15: No. 1, 9-10(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44934 GASEOUS ENVIRONMENT INSIDE A NERVA REACTOR IN SPACE. Clausing, R. E.; Easton, D. S. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 15: No. 1, 203 (Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44935 DESIGN CRITERIA FOR PWR MARITIME POWER PLANTS. Conner III, W. D. (Babcock and Wilcox, Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 15: No. 1, 391-2(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

44936 NASA-LEWIS EXPERIENCES WITH MULTIGROUP CROSS SECTIONS AND SHIELDING CALCULATIONS. Lahti, Gerald P. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 15: No. 1, 566-7(Jun 1972).
From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

Process Heat and Desalination Reactors

Refer also to abstract 43506.

Research and Test Reactors

Refer also to abstracts 42760, 42768, 42769, 42918, and 45052.

44937 LOW TEMPERATURE RESEARCH ON RADIATION DAMAGE. Isebeck, K. Nucl. Active; 27-31(Jan 1971).
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The power-to-reactivity frequency response of the High-Flux Isotope Reactor (HFIR) was measured over the range 0.01 to 5 Hz using periodic binary input signals introduced with normal system control rods. These results served to validate the theoretical model used in the HFIR control and safety studies and to aid in assessing this testing procedure for use in large power reactors where special test equipment or interference with normal operation cannot be tolerated. 10 references. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 42896, 43096, 43195, 43413—43415, 43424, 43425, 43427—43431, 43435, 43436, 43465, 43474, 43475, 43545, 43595, and 43596.

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Reactor Physics and Core Engineering

Physics

Refer also to abstracts 44192, 44618, 44619, 44965, 44967, and 44969.

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45011 ANALYSIS OF GRAIN REACTIVITY EFFECTS USING THE METHOD OF WAELTI. Cobb, W. R. (Nuclear Fuel Services, Rockville, Md.). Trans. Amer. Nucl. Soc.; 15: No. 1, 108-9(Jun 1972).
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45045 ANALYSIS OF NONEQUILIBRIUM PULSE PROPAGATION. Ibrahim, Khalid M.; Miley, George H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 15: No. 1, 518-19 (Jun 1972).
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45046 TRANSMISSION OF FAST-NEUTRON PULSES THROUGH MODERATOR SLABS. Hetrick, D. L. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 15: No. 1, 521-2 (Jun 1972).
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From eighteenth annual American Nuclear Society conference; Las Vegas, Nev. (18 Jun 1972). See CONF-720607.

45049 APPLICATION OF GAMMA SPECTROMETRY TECHNIQUES TO THE DETERMINATION OF NEUTRON FLUXES. Covarrubias, Emiliano Salinas. Mexico City; Instituto Politecnico Nacional (1972). 67p. (In Spanish).

Thesis.

The thermal neutron flux of the reactor at the Mexican Nuclear Center was measured using the foil activation method. The activity induced in the foil was calibrated by the relative method, which consists in the comparison of the radioactivity obtained experimentally with that of a standard. Foils of ^{59}Co 0.127 mm thick were used. The foils were exposed in the central hall, the pneumatic irradiation capsule system, the capsule rotary irradiation system, the exposure room, and the thermal column. Geiger–Mueller and scintillation counter systems were used for measurement of the activities. The results obtained are reported in graphs and tables. (18 figures, 5 tables) (J.S.R.)

GENERAL

Law

Refer also to abstracts 42932, 42934, and 43299.

45050 (INIS-mf-232) REPORT OF THE YEAR 1969/70. (Statens Rad for Atomforskning, Stockholm (Sweden)). 1971. 132p. INIS.

Brief notes are given on atomic scientific research in Sweden. Awarded grants 1969/70 are listed. The Swedish participation in the European organization for nuclear research (CERN) and in the Nordic Institute for Theoretical Atomic Physics in Copenhagen is summarized. (INIS)

45051 (NP-19053) ANNUAL REPORT, 1970. (Kernforschungsanlage, Juelich (West Germany)). 276p. (In German). Dep. NTIS (U. S. Sales Only).

In spite of intensive efforts, the project for high temperature reactors with helium turbine could not be consolidated. In cooperation with industry, the project should be clearly formulated within the next year. Emphasized was the development of fuel elements and other components for the HHT reactor. In the middle of 1970, the decision was made for construction of a 300 MW THTR-prototype-nuclear power plant in Uentrop. In connection with the HTR work, reprocessing of thorium-containing fuel elements could be advanced into a technological flux scheme. The project for nuclear process heat considered designs of reactors with 950°C and 1200°C exit temperatures of cooling medium as well as helium cooling. The incore-thermionic reactor project considered a 20 kW grounded prototype as initial step toward an airworthy reactor. Because of economics, the airworthy state can only be reached through international cooperation. In physics, research centered on plasma and solid state In chemistry, a new institute for applied electrochemistry was projected. In biology, an institute for neurobiology was proposed. Publications issued during the period are listed. (H.B.G.)

45052 (NP-19200) ANNUAL REPORT, 1970. (Centre d'Etude de l'Energie Nucleaire, [Brussels] (Belgium)). 55p. (In French). Dep. NTIS (U. S. Sales Only).

Brief summaries are given of studies done in the areas of research reactors, applied research, basic research, radioisotopes, and health physics. (J.S.R.)

45053 (NP-19348) FIFTH GENERAL REPORT ON THE ACTIVITIES OF THE COMMUNITIES, 1971. (European Communities, Brussels (Belgium). Commission). Feb 1972. 503p. Dep. NTIS (U. S. Sales Only). Office for Official Publications of the European Communities, Luxembourg BF 200.-.

The fifth general report on the activities of the Communities is presented including enlargement, functioning of the common market, economic and monetary union (the nuclear sector is considered with respect to nuclear power plant industries, fuel cycle industries, promotion of industrial uses of radiation and isotopes, construction of reactor prototypes, and Joint Research Center), external relations, institutions and organs of the Communities, and Community law. (D.H.M.)

45054 (SC-M-70-724) RUNKUT: RUNGE-KUTTA INTEGRATOR OF SYSTEMS OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS. Jones, R. E. (Sandia Labs., Albuquerque, N. Mex.). Nov 1970. 51p. Dep. NTIS.

RUNKUT is a computer subroutine which integrates a system of n simultaneous first order differential equations, using a variable step size dual-mesh Runge—Kutta method. It is programmed to allow maximum flexibility of use, yet be reasonably easy to call. RUNKUT is written in Control Data 6600 FORTRAN for the Control Data 6600 computer. (auth)

45055 LEGAL DATA CONCERNING THE MEDICAL APTITUDE FOR WORK IN A CONTROLLED ZONE. Hebert, Jean (Electricite de France, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.): No. 91, 18-24(Sep 1971). (In French).

Legislation concerning the special medical surveillance of workers normally working in a controlled radiation zone is discussed. The regulations concerning the nature of this surveillance, which involves medical examinations to ensure the aptitude of the worker to perform such work, are also discussed. The international norms are examined. Their interpretation by the French authorities in view of their integration into the French legal texts is presented. (France)

Miscellaneous

45056 (ACRH-1000-331) MEDICAL PHYSICS AS A SPECIALTY: CAREER STRUCTURE AND PROMOTION PROSPECTS IN MEDICAL PHYSICS IN THE UNITED STATES. Lanzl, Lawrence H. (Chicago Univ., Ill. Dept. of Radiology. Argonne Cancer Research Hospital, Chicago, Ill.). Apr 1972. Contract AT-(11-1)-69. 6p. (CONF-720435-2). Dep. NTIS.

From Seminar on training and education in medical physics; Kiel, Germany (10 Apr 1972).

45057 (ACRH-1000-332) QUALIFICATION AND CERTIFICATION: THE USE OF DIFFERENT EXAMINATION METHODS. Lanzl, Lawrence H. (Chicago Univ., Ill. Dept. of Radiology. Argonne Cancer Research Hospital, Chicago, Ill.). Apr 1972. Contract AT(11-1)-69. 8p. (CONF-720435-3). Dep. NTIS.

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45060 (ANL-Trans-911) NOTE ON ELECTRONIC CORRELATION FACTORS APPLICABLE TO MOLECULAR CALCULATIONS. David, D.-J. Translated for Argonne National Lab., Ill., from French report. 7p. Dep. NTIS.

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45062 (BDX-613-337(Rev.)) DIAGNOSIS OF MALFUNCTIONS IN COMPLEX ELECTRONIC ASSEMBLIES. Final Report. Losure, J. A. (Bendix Corp., Kansas City, Mo.). Sep 1971. Contract AT(29-1)-613. 63p. Dep. NTIS.

45063 (BDX-613-465(Rev.)) SOLDER LEVELING APPLIED TO MANUFACTURING. Final Report. Hall, W. H. (Bendix Corp., Kansas City, Mo.). Oct 1971. Contract AT(29-1)-613. 25p. Dep. NTIS.

45064 (BDX-613-502(Rev.)) THIN INSULATOR SHAPES. Daly, J. C. (Bendix Corp., Kansas City, Mo.). Jan 1972. Contract AT(29-1)-613. 19p. Dep. NTIS.

45065 (BDX-613-540(Rev.)) DIRECT NUMERICAL CONTROL OF MACHINE TOOLS. Finlay, G. L. (Bendix Corp., Kansas City, Mo.). Jun 1972. Contract AT(29-1)-613. 74p. Dep. NTIS.

45066 (BDX-613-703) LASER INTERFEROMETER SCALING COUNTER. Wonnell, L. D. (Bendix Corp., Kansas City, Mo.). May 1972. Contract AT(29-1)-613. 35p. Dep. NTIS.

45067 (BDX-613-704) QUANTITATIVE STUDY OF THE SPECTRAL DISTRIBUTION OF LOW ENERGY X-RAY DEVICES. Heckman, R. V. (Bendix Corp., Kansas City, Mo.). May 1972. Contract AT(29-1)-613. 25p. Dep. NTIS.

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45070 (BNL-16906) ATMOSPHERIC SULFUR AND ITS LINKS WITH THE BIOSPHERE. Hill, Frank B. (Brookhaven National Lab., Upton, N. Y.). 1972. 49p. (CONF-720510-1). Dep. NTIS.

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45073 (BNWL-1562-AOPG) OPS: RISK ANALYSIS IN CAPITAL INVESTMENT AND DEVELOPMENT OPPORTUNITIES. Legan, R. W.; Engel, R. L. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972. Contract AT(45-1)-1830. 56p. Dep. NTIS.

45074 (BNWL-SA-3817(Rev.1)) INTRODUCTION TO CORROSION CONTROL DESIGN. Perrigo, Lyle D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 1972. Contract AT(45-1)-1830. 36p. (CONF-720538-1). Dep. NTIS.

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From fifth Karolinska symposium on gene transcription in reproductive tissue; Stockholm, Sweden (29 May 1972).

45078 (CONF-720537-1) HISTOPATHOLOGY OF MYCOBACTERIUM BOVIS (BCG)-MEDIATED TUMOR REGRESSION. Hanna, M. G. Jr.; Snodgrass, M. J.; Zbar, B.; Rapp, H. J. (Oak Ridge National Lab., Tenn. National Cancer Inst., Bethesda, Md.). 1972. 29p. Dep. NTIS.

From Conference on immunology of carcinogenesis; Gatlinburg, TN. (8 May 1972).

45079 (CONF-720537-2) IMMUNE SUPPRESSION AND CARCINOGENESIS IN HAMSTERS DURING TOPICAL APPLICATION OF 7,12-DIMETHYLBENZ(a) ANTHRACENE (DMBA). Szakal, A. K.; Hanna, M. G. Jr. (Oak Ridge National Lab., Tenn.). 1972. 30p. Dep. NTIS.

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45080 (COO-1198-908) NUCLEAR MAGNETIC RESONANCE ON THE KONDO EFFECT. Lo, David Chan-Wai (Illinois Univ., Urbana). Jun 1972. Contract AT(11-1)-1198. 137p. Dep. NTIS.

45081 (COO-1329-17) CHANGES IN JACKRABBIT MORTALITY RATE AND DENSITY LEVEL AS A FUNCTION OF COYOTE PREDATION. Stoddart, L. Charles (Utah State Univ., Logan. Dept. of Wildlife Resources). [nd]. Contract AT(11-1)-1329. 16p. (CONF-710455-1). Dep. NTIS.

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45082 (COO-1469-204) OUTLINING AND SHADING GENERATION FOR A COLOR TELEVISION DISPLAY. Hanson, Donald Farness (Illinois Univ., Urbana. Dept. of Computer Science). Jun 1972. Contract AT(11-1)-1469. 120p. (UIUCDCS-R-72-512). Dep. NTIS.

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45083 (COO-1469-205) OPERATING MANUAL FOR DIFMF3. A Program to Solve Initial Conditions in Simultaneous Differential Equations. van Melle, Bill (Illinois Univ., Urbana. Dept. of Computer Science). Apr 1972. Contract AT(11-1)-1469. 23p. (UIUCDCS-F-72-870). Dep. NTIS.

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45087 (COO-2115-3) STATISTICAL STUDY OF BASIC ECOLOGICAL VARIATIONS IN A SHORTGRASS SITE. Technical Progress Report, September 15, 1971-September 14, 1972. Bonham, Charles D. (Colorado State Univ., Fort Collins. Dept. of Range Science). 1972. Contract AT(11-1)-2115. 21p. Dep. NTIS.

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The reader is also referred to *Guide to Abstracting and Indexing for Nuclear Science Abstracts* (USAEC report TID-4576).

Most headings in the subject index are the names of specific materials, things, and processes. Each heading is followed by a modifier that describes the properties of, or processes applied to, that heading.

All index entries cite *NSA* volume and abstract numbers; volume number precedes the colon and the abstract number follows it. The designation (R) following the abstract number indicates a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Report numbers, where applicable, are included in parentheses after the abstract number of the citation. Published literature (journal article or book) can be identified by the absence of a report number.

Ideas presented in the original literature, rather than key words, have been indexed. The indexers have selected what seemed the most probable and logical place to look for typical information. Since it is not always possible to anticipate where a user would look for information, the cumulative indexes include numerous cross references. Consideration of synonymous or closely related terms will prove valuable.

Information is indexed for the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use or to the general class headings that include the specific headings. For example, information on boiler design for the Fermi Fast Breeder Reactor would be indexed under the headings BOILERS and FERMI FAST BREEDER REACTOR but not necessarily under the headings REACTORS, FAST or REACTORS, BREEDER.

General or broad headings are reserved for general summaries, reviews, comprehensive reports, and similar literature.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings; e.g., AMINO ACIDS rather than ACIDS, AMINO; HELIUM ISOTOPES He-4 rather than HELIUM—ISOTOPES He-4 or HELIUM—He-4 ISOTOPES. Note, however, that in some cases parenthetic modifying terms or inverted headings such as NEUTRONS, FAST, are used where the alphabetical arrangement of a direct entry would cause information to be scattered. In addition, organic compounds are usually entered in the index in the inverted form to facilitate grouping like or related compounds with the parent compounds; e.g., BENZENE, BROMO- rather than BROMOBENZENE.

Alphabetization

Subject headings are alphabetized word by word. Parenthetic qualifiers, numbers, and Greek letters within subject headings are disregarded in alphabetizing unless there are two or more headings that are otherwise identical, in which case the qualifier, numerical progression, or spelled names for the Greek letters determine the order.

Examples:

M-Capture
  see ELECTRON CAPTURE
MAGNESIUM
MAGNESIUM ALLOYS AND SYSTEMS
MESONS
MESONS (π)
MESONS (rho)
1-PENTANOL
2-PENTANOL
URANIUM OXIDES
URANIUM OXIDES UO_2

Modifying Phrases

The modifiers appearing under a subject heading are written specifically to show the relation between the item being indexed and the heading. The modifier therefore contains a maximum of useful information. Although the modifier begins with the word judged to be of greatest use to the greatest number of users, there is still need for the searcher to consider all modifiers under the heading(s) of interest.

Modifiers usually form meaningful phrases when combined with the subject heading. Some are intended to be read following the subject heading, e.g., the entry HYDROGEN—*sorption by charcoal,* should be read *hydrogen sorption by charcoal.* As a result of placing the important word first, however, many modifiers must be rearranged for smooth reading, e.g., FORMALDEHYDE—*yields in radiolysis of ethyl ether, effects of deuterium on,* should be read *effects of deuterium on formaldehyde yields in radiolysis of ethyl ether* and URANIUM—*crystal structure of, effect of cooling rate on allotropic transformations in,* should be read *effect of cooling rate on allotropic transformations in crystal structure of uranium.*

Special characters are added to modifiers in the fields of physics and reactor technology; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the abstract number.

Physical States and Configurations of Materials

The specific physical state, if other than normal, or the geometric configuration of the material is included in the modifying phrase; e.g., information on liquid metals is indexed under the specific metal with "liquid" in the modifier and carbon crucibles is indexed under CARBON with "crucibles" appropriately placed in the modifier. The information on carbon crucibles is also indexed under CRUCIBLES.

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed to subject headings in the direct form. Cations are listed in the order of increasing valence for polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., SODIUM ALUMINUM SILICATES and POTASSIUM SODIUM SULFATES. If more than one anionic species is presented in a compound, the anions are arranged alphabetically, e.g., BERYLLIUM FLUORIDE HYDROXIDES.

Nomenclature of Organic Compounds

Complex organic compounds occur in such variety as to require a systematic nomenclature. Headings for most substituted organic compounds are found in an inverted form following names of the parent compounds. Examples of two such headings are:

```
2,4-HEPTANEDIONE
2,4-HEPTANEDIONE, 1-PHENYL-
```

Headings are included for broad class names of enzymes, e.g., HYDROLASES and TRANSFERASES. Specific enzyme names are to be found in modifiers under these headings. Similarly, broad class names for hormones are included as headings, except in this case the headings are entered in the inverted form as, e.g., HORMONES, ADRENAL and HORMONES, SEX. The more specific names of hormones are to be found in the modifiers under the appropriate broad headings.

For compounds used as drugs, an effort is made to use subject headings that reflect the recommendations of the USAN (United States Adopted Names) compilation or the "New Names" columns of the *Journal of the American Medical Association.* The *Merck Index* has also been used in selecting subject headings for drugs.

Nomenclature of Life Sciences

Except for those in the phylum Tracheophyta, subject headings for plants are common names. For example, ALGAE, FUNGI, SLIME MOLDS, MOSSES, and LIVERWORTS are subject headings. The phylum name TRACHEOPHYTA and several classes and subclasses belonging to it are entered as subject headings. The specific classes entered are PSILOPSIDA, LYCOPSIDA, SPHENOPSIDA, and PTEROPSIDA. The three subclasses FILICINIDAE, GYMNOSPERMIDAE, and ANGIOSPERMIDAE which belong under Pteropsida are also subject headings. Scientific names (genus and species) and common names if known are used in the modifying phrase.

Subject headings for microorganisms are VIRUSES, RICKETTSIA, and BACTERIA. The name of the type or kind of virus or the genus and species names of the organisms should appear in the modifying phrase.

The names of animal phyla are subject headings. The arthropods are also indexed to subject headings for classes INSECTA, CRUSTACEA, ARACHNIDA, DIPLOPODA, and CHILOPODA. The invertebrate chordates are indexed to subject headings UROCHORDATA and CEPHALOCHORDATA. The vertebrates are indexed to headings for the classes AGNATHA, CHONDRICHTHYES, OSTEICHTHYES, AMPHIBIA, REPTILIA, AVES, and MAMMALIA as well as to the general heading VERTEBRATA. Common names are used as subject headings in the class Mammalia.

Subject headings are entered for various classes of commodities, and specific products are identified in the file-word position of the modifier. In the following examples, approved subject headings are capitalized and typical modifier file words are listed in lower case.

Example 1	Example 2
CEREALS	MEATS
bread	beef
flour	fish
oats	mutton
rice	pork
rye	poultry
wheat	seafood

Diseases, pathological conditions, and in vitro studies of atypical cells and tissues are indexed under subject headings for the organism affected, under the appropriate anatomical structure of physiological phenomenon affected, and under the appropriate disease heading. Subject headings for diseases (defined as any deviation from the norm) are common names such as ANEMIA, FIBROSIS, INFECTIONS, LEUKEMIA, NEOPLASMS, and RADIATION SICKNESS. Also, the general headings DISEASES and DISEASES, PLANTS are available as subject headings.

Multicomponent Alloys and Other Systems

Multicomponent alloys and systems, except those with well-known trade names, are indexed under a subject heading for each component in the form "element systems" for nonmetals or "element alloys and systems" for metals. The modifier begins with element symbols for each component arranged alphabetically. In addition, if significance is placed on the base metal of the alloy, this is indicated by adding "-base" to the element symbol.

Example: A 1.5C, 12Cr, 0.25V, 0.8Mo, bal Fe alloy is indexed as

```
CARBON SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
CHROMIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
IRON ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
MOLYBDENUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
VANADIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
```

Well-known alloys, such as ZIRCALOY-2, are indexed under the trade name; cross references from each component of the alloy to the trade name appear in cumulative indexes.

Multicomponent systems in which nonmetallic elements are present in large percentage and which are commonly referred to as systems or mixtures are indexed in a manner similar to alloys.

Example: A tungsten–silicon preparation is indexed as

```
TUNGSTEN ALLOYS AND SYSTEMS
  Si--W, ...
SILICON SYSTEMS
  Si--W, ...
```

Multicompound systems and mixtures of inorganic compounds are indexed under the subject heading for each component compound; the modifiers begin with an alphabetical listing of compound formulas.

Example: A lead titanate–lead zirconate mixture is indexed as

```
LEAD TITANATES
  PbTiO₃--PbZrO₃
LEAD ZIRCONATES
  PbTiO₃--PbZrO₃
```

Mixtures of organic compounds are indexed under subject headings for each component of the mixture; the modifiers begin with an alphabetical listing of compound names.

Example:

```
ACETIC ACID
  acetic acid--BF₃, ...
BORON FLUORIDES
  acetic acid--BF₃, ...
```

Example:

```
BENZENE, CHLORO-
  bromophenol--chlorobenzene, ...
PHENOL, BROMO-
  bromophenol--chlorobenzene, ...
```

A mixed system of compounds and elements is indexed by a combined form of the preceding conventions; e.g., a dispersion of copper and alumina would be indexed as

```
ALUMINUM OXIDES
  Al₂O₃--Cu, ...
COPPER ALLOYS AND SYSTEMS
  Al₂O₃--Cu, ...
```

If modifiers for alloys and systems are included with other modifiers under the same subject heading, they are filed last.

Example:

```
CARBON SYSTEMS
  deposition on nuclear fuel
    particles
  molecular structure of
  neutron total cross section for
  sorptive properties for xenon
  Young's modulus for
  Al--C--Cr, superconductivity in
  B--C, phase studies for
  C--U--Zr, fabrication and
    physical properties of
```

Nomenclature of High Energy Physics

Information on particle-particle events is indexed under subject headings for the specific particles involved. The modifier file word *interactions* is followed by the specific interaction written in symbolic form. Particle nomenclature and symbols follow that of the Particle Data Group published in *Review of Particle Properties* (latest revision). For consistency the incident particle is always written first. The mass (in MeV) of a resonance state is included in parentheses after the symbol to avoid ambiguity. Hyperfragments are indicated in modifiers as in the following examples: Λ-He^5, Σ-H^3, $\Lambda\Lambda$-Be^{10}. The superscript on the right indicates the total number of baryons in the composite system.

Examples:

```
MESONS (π⁻)
  interactions π⁻ + p → Λ + K⁺ + π⁻ at 6 GeV/c in
    hydrogen bubble chamber, ΛK(1700) enhancement
    in, (E)
BARYONS, RESONANCE (Δ)
  production of Δ⁺⁺(1236) and Δ⁰(1236) from K⁻ +
    p → K⁻ + p + π⁺ + π⁻ interactions at 2.63 and
    2.70 GeV/c, (E)
HYPERNUCLEI
  binding energy of ΛΛ-He⁶, three-body α--Λ--Λ
    model for
```

Subject headings are also provided for specific models and theories.

Examples:

```
ELEMENTARY PARTICLE MODELS
  quark, hadron total cross sections in,
    numerical analysis of
CURRENT ALGEBRA
  PCAC hypothesis for A₁ and rho dominance in π →
    e + ν + γ decay
REGGE POLE THEORY
  predictions for polarization in K⁻ + p → anti
    K⁰ + n, π⁻ + p → π⁰ + n, and π⁻ + p → eta + n
    interactions at high energies
SYMMETRY GROUPS
  SU(2) x SU(4) intermediate-coupling model for
    nucleon and hyperon isobars
```

Nomenclature of Reactor Technology

Subject headings for reactors are of three types:

(1) Specific reactors, e.g., ARGONNE RESEARCH REACTOR, SAXTON POWER REACTOR

(2) Reactors having a common physics or engineering characteristic, e.g., REACTORS, FAST; REACTORS, ORGANIC-COOLED; REACTORS, PRESSURIZED-WATER

(3) Reactors having a common purpose, e.g., REACTORS, POWER; REACTORS, RESEARCH

Information on specific reactors, type (1), is indexed under the one specific subject heading. Information on classes or types of reactors, types (2) (characteristics) and (3) (purpose), is indexed under all applicable headings. For example, information on a heavy-water-moderated organic-cooled power reactor is indexed under REACTORS, HEAVY WATER-MODERATED; REACTORS, ORGANIC-COOLED; and REACTORS, POWER.

Subject headings exist for selected reactor components, e.g., REACTOR FUEL ELEMENTS. When applicable, headings for components are indexed even though they may have been included in a modifier under a type (2) or (3) heading. The materials in reactor components are indexed when the information is peculiar to the material.

Modifier file words under reactor headings are of two primary types: one type expresses reactor characteristics, e.g., reactivity; the other, components, e.g., control rod. If no subject heading appears for a reactor component, the heading REACTORS is used, and the component is used as the modifier file word.

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